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Pittsburgh

THE UNITED GAS IMPROVEMENT COMPANY,

PHILADELPHIA.

BUILDERS OF

THE STANDARD DOUBLE SUPERHEATER

LOWE WATER GAS APPARATUS.

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OF

AIR AND STEAM SUPPLY

(PATENTED),

AFFORDING { **PERFECT CONTROL OF GENERATOR FIRE CONDITIONS.**

PRODUCING { **UNIFORM RESULTS. HIGHEST EFFICIENCIES.**

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Depreciation Accounting.

[Read before the Wisconsin Gas Association by HON. HALFORD ERICKSON, of the Wisconsin Railroad Commission.]

The subject, depreciation, is so comprehensive in scope and far reaching in its effects that it cannot be fully discussed in a short paper. All I shall do at this time is to endeavor to point out a few of the more important facts relating to the methods of providing for depreciation, and how it should be recorded or accounted for on the records of utilities. Such phases of depreciation, as its nature, the necessity of providing for it, the determination of the life of the property upon which the rate of depreciation depends, the distinction between that part of depreciation which should be covered by charges to repairs and that part which should be covered by charges to depreciation proper, and other matters outside of these, I shall touch upon but lightly. The accounting side of depreciation was selected for this discussion at the suggestion of your president and because many of the questions involved therein are still far from settled.

By depreciation is usually meant the gradual lowering of value of a property due to wear and tear of the smaller parts of the larger units, obsolescence of equipment because of progress in the art, and inadequacy or the necessity of substituting larger or more effective units for those in use.

In most systems of accounting, upkeep or minor repairs are charged directly to the maintenance accounts, while replacing of the larger parts that must be made from time to time are charged to depreciation. What is thus termed depreciation is as much an operating expense as ordinary repairs or maintenance. Investors justly insist that such depreciation shall be made good in the charges made for the service rendered. If it is not made good in some such way their investment would sooner or later be an almost total loss. Without proper provision for depreciation the plants would in a short time be unable to render efficient service. When rates are high enough to cover such depression it follows, as a matter of justice, that the amounts so earned for depreciation should be set aside for the purpose for which they were collected, and not withdrawn from the business in the form of dividends or used for any other purpose. There are many reasons why it is important that the amounts thus collected for depreciation should be kept on hand until needed, and then devoted to proper purposes. Unless they are so set aside there cannot always be real assurance that the service will be kept up to adequate standard; without some such reserve to draw on, it is often difficult for plants whose credit is strained to secure money for the extensive renewals frequently necessary in the public utility business. The chances also are that if the amounts earned for depreciation have not been properly set aside, the present value (cost new less depreciation), rather than the original cost, or the cost new, will be used as the basis for the valuation of the plant. At any rate, there is a marked tendency in this direction on the part of appraisers. They appear to regard depreciation earned and improperly withdrawn in about the same light as the withdrawal of capital from the business. For many plants omission of depreciation from the value upon which rates are based is likely to result in rates considerably lower than would otherwise be, and the loss through the lower rates may in the long run be greater than the temporary gains from withdrawing the depreciation allowance from the business.

The omission of the depreciation charges from operating expenses results, of course, in higher net earning than if the depreciation allowances are included, but failure to charge expenses with depreciation creates false net earning which may lead to higher than reasonable valuation of the plant for taxation and similar purposes. In appraising property for taxation the assessors aim to find the market value, and this value is often determined by capitalizing the net earnings on about a 5 or 6 per cent. basis. Now, if the net earnings are too high, because depreciation has not been included in expenses, it necessarily follows that the assessed valuation will also be too high and that the plant is made to bear higher taxes than should be levied on it. The amounts thus earned for depreciation, if set aside, will also constitute valuable assets. They would be a reserve from which money for new extensions could be borrowed, until the outlays could be conveniently financed in the regular way. They might enable the plant to do business on a cash basis and profit by discounts and other advantages that usually accrue from having ready cash. Many other reasons for making adequate allowances for depreciation, and for devoting these allowances or reserves to their proper purposes might be given. Those which have been outlined, however, seem sufficient to show that these matters are important enough for proper consideration.

The full significance of depreciation does not seem to have been realized until within the last few years. In fact it was not generally placed in its proper light until after the establishment of public ser-

vice commissions. Even the Courts have differed in their opinions as to the nature and proper treatment of depreciation. Their present position in the matter is expressed by the United States Supreme Court in the so-called Knoxville Water Case, where it is in substance held that public utilites not only have the right to cover depreciation in their rates, but that it is their duty to make proper provision for such depreciation. The opinion reads in part as follows:

"Before coming to the question of profit, the company is entitled to earn a sufficient sum annually to provide not only for current repairs, but for making good the depreciation, and replacing the parts of the property when they come to the end of their life. The company is not bound to see its property gradually wasted, without making provision out of its earnings for its replacement. It is en titled to see that from earnings the value of the property invested is kept unimpared, so that at the end of any given term of years the original investment remains as it was at the beginning. It is not only the right of the company to make such a provision, but it is the duty of its bond and stockholders, and, in case of a public service corporation at least, its plain duty to the public. If a different course were pursued the only method of providing for replacement of property which has ceased to be useful would be the investment of new capital and the issues of new bonds and stocks. This course would lead to a constantly increasing variance between present values and bond and stock capitalization, a tendency which would inevitably lead to disaster, either to the stockholders or to the public or both."

The public utility law of Wisconsin is in harmony with this opinion. It recognizes the importance of providing for depreciation and sets forth the right of the utility to earnings sufficient to meet this item. It furthermore places the duty upon the utility to provide for depreciation and to use the provisions so made for the proper purposes. The opinion is in line with the more advanced ideas on the subject and appoars just both to the public and the utilities.

The rate of depreciation is mainly determined from the cost and the useful life of the property. The life of the property is determined partly from actual inspection and from past experience under similar conditions. After the life of the property has been estimated, it is usually grouped or classified according to its life and the annual allowance for depreciation, computed either on the so called straight line or on the sinking fund method, although other methods are occasionally used. Under straight line method the annual allowance for depreciation or that which is required to keep the investment intact is arrived at by dividing the cost new less scrap value of each group by the estimated life of the group. The sum of the allowance for all groups gives the total annual amount. The rate of depreciation is obtained by dividing this total annual allowance for the plant as a whole, by the cost new less scrap value of all depreciable property.

TABLE I.—*Straight Line Method.*

Class.	Life.	Cost of Reproduction. New.	Scrap Value.	Cost New Less Scrap.	Annual Per Cent. Depreciation.	Annual Amount Required to Cover Depreciation.
A.....	5	$210	....	$210	20.00	$42
B.....	8	7,124	14	7,110	12.50	889
C.....	10	17,361	153	17,208	10.00	1,731
D.....	12	26,272	....	26,272	8.33	2,188
E	15	143,470	11,920	131,550	6.67	8,774
F.....	16	65,632	33,374	32,258	6.25	2,016
G.....	20	113,336	9,239	104,097	5.00	5,205
H.....	25	43,747	7,631	36,116	4.00	1,445
I.....	50	14,337	....	14,337	2.00	287
J	60	1,165	....	1,165	1.67	19
K.....	75	21,920	....	21,920	1.33	292
		$454,574	$62,331	$392,243	....	$22,878
		12 pr. ct. overhead..		47,069	5.83	2,745
				$439,312		$25,623

$\frac{22,878}{392,243}$ = 5.83 per cent.

This table shows the cost new less scrap value as $439,312, and the annual amount to be set aside for depreciation, $25,623. The annual rate for depreciation varies from 20 per cent. for the property in the 5-year group, to 1.33 per cent, for the 75-year group; and the average rate 5.83 per cent.

Under the sinking fund method it is assumed that the amounts allowed for depreciation are invested, and the interest on them helps to make up the annual provision for depreciation. Since the interest as well as the principal becomes part of the annual provision for depreciation, it follows that the annual charges to operating expenses need not be as large as when no interest is included. The annual allowance necessary for each group of property is derived by multiplying the cost new less scrap, of each group, by the rate gotten from sinking fund tables. The sum of the allowances for all groups gives the total annual amount necessary exclusive of interest. Dividing the total annual allowance by the cost new, less scrap, of all the property will give the rate of depreciation.

TABLE II.—*Sinking Fund Method.*

Class.	Life.	Cost of Reproduction New.	Scrap Value.	Cost New Less Scrap.	Annual Reserved on 2 Per Cent. Basis.	Annual Charge to Operating Expenses Required.
A.....	5	$210	....	$210	19.21	$40
B.....	8	7,124	14	7,110	11.65	828
C.....	10	17,361	153	17,208	9.13	1,571
D.....	12	26,272	. ..	26,272	7.46	1,960
E.. ...	15	143,470	11,920	131,550	5.78	7,604
F	16	65,632	33,374	32,258	5.36	1,729
G.....	20	113,336	9,239	104,097	4.12	4,289
H	25	43,747	7,631	36,116	3.12	1,127
I	50	14,337	....	14,337	1.18	169
J	60	1,165	....	1,165	.88	10
K. .. .	75	21,920	....	21,920	.58	127
		$454,574	$62,331	$392,243	. ...	$19,454
		12 pr, ct.	overhead..	47,069	49.59	2,334
				$439,312		$21,788

$\frac{19,454}{392,243}$ = 4.959 per cent.

This table shows that on a 2 per cent. sinking fund basis the amount that must be annually charged to operating expenses for depreciation is $21,788 or about 4.96 per cent. of the property value.

The straight-line method is generally preferred. It is argued that it is much simpler and more easily understood and worked than the sinking-fund method, and more equitable under many conditions and for some purposes. It is said to be less economical than the sinking-fund method, especially for purposes of financing depreciation, because it requires a somewhat greater annual charge to operating expenses. It is also said that the straight-line basis, when used for determining present value, results in too much of a reduction therein, and that under some conditions it is unfair to the owners of the property. The sinking-fund method also has its advocates, and is often considered the most economical method for the public when questions of financing are involved. On the other hand it is said to be complicated, and to assume conditions more stable than those that actually obtain. It is also contended that under the sinking-fund method the amounts set aside must be segregated into a separate fund, which segregation is held to be objectionable from several points of view. Whether all of these objections can be justly directed against the sinking-fund method is questionable. In order to understand this matter it may be well to see wherein the administration of the sinking-fund method differs from the straight-line method when applied to typical operating enterprises.

To figure depreciation under any method it is necessary to determine the cost and the life of the property, and to group it according to its years of life in such a way as to show the cost new and scrap value for each life group. It appears that the most complicated and difficult part of the work is that of estimating the probable life of the different classes of property that make up a utility plant. (See Tables I and II.) Any errors or omissions in the life tables will work injustice under either method, and these cannot be used as valid arguments either for or against either method. The next step is to determine the annual charge to be made to operating expenses. Under the straight-line method, as intimated, the amount to be set aside for each group is arrived at by dividing the cost new less scrap value of each group by the life of that group. When the allowance is divided by the cost new less scrap value of the property, the rate of allowance is obtained. Under the sinking-fund method the cost new less scrap value for each group is multiplied by the percentage for that group derived from a sinking-fund table. The total of the allowances for the groups equals the annual charge to operating expenses. Dividing the total charge necessary by the cost new less scrap gives the rate of depreciation.

These comparisons of the way of arriving at the annual charges to operating expenses and the rates of depreciation under the two meth-

ods show that it is little or no more difficult under one method than under the other. When the rate for computing the annual allowance for depreciation has been determined it would seem best that it should be consistently used until, because of the changes in the property or in the relation of the various property groups to each other, it becomes necessary to find a new rate. However, any change in rate, necessary because of changes in the property would apply as much under the straight line as under the sinking fund method. From the accounting point of view the principal difference between the two methods is this: That under the straight line method the annual allowance for depreciation is obtained from only one source, or from charges to the operating expenses alone; while under the sinking fund method the annual allowance is obtained from two sources; charges to the operating expenses and interest received for the use of depreciation balances. The arguments that in order that interest may be had for the use of the depreciation balances it is necessary to segregate the amounts set aside into a reserve fund do not seem to be supported by the facts. For instance, there does not seem to be any good reasons why assets offsetting the depreciation reserve cannot be as effectively employed for interest earning purposes as balances in the depreciation reserve fund. All that is necessary in either case is that such assets and balances be available for use, and that opportunities are offered for their profitable employment. The confusion upon this point is probably due to failure to note the difference between the sinking fund method of providing for depreciation and sinking fund requirements for the retirement of bonds. It is an open question whether it is advisable to establish a depreciation reserve fund at all. To do so it is necessary to transfer to it the cash or other assets held against the depreciation reserve.

Further, in order that interest may be earned on the assets transferred it is necessary that the balance in the fund be loaned or temporarily invested in such a way that it will earn something and be readily available when needed for renewals. As these assets or balances can be as well, if not better, used or invested while standing as offsets to the depreciation reserves, the creation of a reserve fund will only place additional restrictions upon their use. It will probably result in this: That the amounts set aside for depreciation will in part find their way into the reserve fund and in part be held as offsets to the reserve account. Whether the provisions for depreciation are placed in the reserve fund or merely treated as offsets to the reserve account would not seem to be of vital importance at any rate when the affairs of the plant are properly managed. The amounts set aside for depreciation, while held awaiting use for renewals should, however, be advantageously employed. Opportunities for such employment are numerous, but none would seem to be more advantageous and economical from a business point of view than these offered by the extensions to plant needed from time to time. Such employment may enable extensions to be made when capital could not be obtainable in any other way. It is also, as a rule, fairly well secured against ordinary risks, and besides is likely to bring better returns than could be obtained elsewhere. It must be understood, however, that such use of these assets should not he considered a permanent investment, but rather in the nature of a loan; and that whenever needed for renewals the loan must be returned to the reserve. The use of assets offsetting the reserve for plant extensions therefore merely *postpones* the time when additional capital securities must be issued for the cost of these extensions. As such loans tend to defer, sometimes for years, the issuing of capital securities for extension, and interest payments thereon, they often result in considerable saving to the plant. It would even seem that for a permanent plant owing to the fact that its cost new less depreciation will always be much less than the cost new, a part of the amount set aside to keep the investment intact might be permanently withdrawn and returned to the investors. But return of part of the investment would be the same thing as withdrawing an equal proportion of the capital invested, and would, therefore, reduce the basis upon which returns for interest and profits should be allowed. It would also alter the basis upon which the depreciation allowances are computed, especially under the sinking fund method. While withdrawal of a part of the capital might be practical, it is so closely connected with other conditions that it is doubtful whether in the end it would be in line with the best policy. The assets offsetting the depreciation reserve might at times be profitably used as additional working capital, or for other more or less temporary purposes in the operation of the plant. When such assets are in form to permit it, there are also times when it is more convenient and less costly to borrow for current use from these assets than from the banks. Instances in point might easily be mentioned were this thought necessary.

It is of course necessary for utility managers to use discretion in determining how much of the depreciation reserve should be represented by plant, and how much by other assets. Care should be taken that the policy adopted will not injure the service. The provision for depreciation is contributed by the consumers through the rates they pay, and they are entitled first of all to reasonably adequate service. Any use of the moneys that impairs the service is in violation of the principles which justify an allowance for depreciation, and should be avoided. Whether the amounts set aside for depreciation should be placed in a reserve fund seems to depend upon the character of the management and the circumstances under which the plant is operating. For some plants that course may be the best; for other plants not. There are also likely to be plants whose interests are best protected when a part of these assets are placed in the reserve fund and the rest employed for current purposes.

From a financial point of view the principal difference between the straight line and the sinking fund methods is that under the latter method the annual direct charge to operating expenses, or to the customers, is somewhat smaller than under the straight line method. Whether the sinking fund method is in the end the more economical to the customers depends upon other conditions. Everything considered, however, probably the sinking fund method is best, especially for permanent enterprises, like public utilities. It is, as you know, used by the railroad commission whenever the conditions permit it. Since under the sinking fund method it is necessary that the balance held until needed for renewals be so used or invested as to bring in something in the way of interest, the question arises as to the basis upon which such interest should be figured. In the first place it cannot be safely assumed that the entire balance can always be made to earn interest. If any part of it remains idle for a time, the interest is reduced by that much. Then again the safety of the investment must be taken into account. Balances of this kind should not be placed in risky undertakings, small risks and low rates of interest usually go together. Banks and trust companies do not pay more than 3 or 4 per cent. on deposits, and first class bonds and mortgages readily converted into cash, yield but little more. Depreciation balances, because of the circumstances involved, are likely to yield even lower rates than these, and it is not safe to assume that they will regularly earn more than from 2 to 4 per cent. on their total.

The interest received should be as carefully accounted for as any other part of the revenues. In the income account, for instance, they may be shown both as non-operating revenues and as deductions from gross income. When thus presented they can be fully taken into the accounts without affecting the net earnings from operation. Since depreciation is an operating expense, it should be charged to operating in monthly or other periodical allowances. When regularly charged in this way there is likely to be fairly close agreement between the sum of the charges and the amount of the depreciation that has taken place in the property.

After having determined the annual provision for depreciation the next question of importance is the bookkeeping machinery necessary to properly record all the transactions from the time the provisions are made until the property is renewed. In considering this question of accounting some understanding of the meaning of the names of more important accounts is important. Unfortunately accounting terminology is not fully standardized, especially depreciation accounting. Three accounts are of special importance, "Depreciation," "Depreciation Reserve" and "Depreciation Reserve Fund."

"*Depreciation*" is the operating expense account to which the annual estimated depreciation is charged. This operating expense should show the charges for depreciation that enter into the cost of the service, and which are intended as an offset to the depreciation that has taken place in the plant and equipment.

"*Depreciation Reserve*" is credited with the amount set aside for depreciation, and which, as stated, is charged to the depreciation account; and it is credited with the interest received for the use of the balances held for depreciation. This account appears either on the right-hand side of the Balance Sheet among the liabilities, or as a deduction from Property and Plant. If correctly kept, the balance in the account measures the lessening in value of the plant and equipment caused by the various forms of depreciation. It is designed to show the amount that has been reserved from earnings to cover depreciation. The balance represents the difference between the total amount reserved and the charges made to this account for renewals

of property. The reserve account on the right-hand side of the balance sheet is on debit side of the balance sheet, offset by the various assets that have resulted from the setting aside of depreciation.

"*Depreciation Reserve Fund*" is an asset account, and always appears on the left hand side of the balance sheet. It is charged with all the assets especially set aside for depreciation and transferred to the fund, and debited when these assets are withdrawn for renewals. This reserve fund account may thus contain cash, securities and other items of value that can be used for the replacement of worn out equipment or property. The assets included in the fund may thus equal all or only a part of the assets represented by the depreciation reserve, depending upon what proportion of the latter have been transferred to the fund. When these transfers cover all the assets reserved for depreciation, the balance in the depreciation reserve fund should agree with the amount of accrued depreciation not covered by renewals.

The bookkeeping entries required in accounting for depreciation are simple. The methods of determining the annual charges to operating expenses under the straight line and sinking fund methods have been outlined above, and this amount divided by 12 will give the monthly charge. The monthly or other periodical charge having been determined, a journal entry is made each month, or other period, charging "Depreciation" and crediting "Depreciation Reserve" with the amount of the allowance. (Illustration I). From the journal the items are posted to the proper accounts in the "General Ledger." When the financial statements for the month or period are made-up, "Depreciation" is thus included in the income account as one of the operating expenses to be deducted from revenues before net earnings are determined. The Depreciation Reserve balance is either included among liabilities or may be shown as a reduction from property and plant. The practice of carrying the depreciation reserve among the liabilities is the one favored by the Railroad Commission of Wisconsin.

The fact that the "Depreciation Reserve" account is credited when the "Depreciation" account is debited indicates the manner in which earnings are reserved for the lessening of the plant value or for depreciation. The total credits to the reserve indicates the amount that has to be withheld from revenue to meet the element of depreciation.

Under this head by the sinking fund method, because of interest accretions, one entry is required in addition to the one discuseed above, a debit to "Interest" and a credit to depreciation reserve. (Illustration II.)

The next group of entries relates to the renewal or replacement of the depreciated property. The importance of providing for depreciation is not fully apparent until the equipment becomes useless for operating purposes. Before new units can be installed the old units must be removed. When the renewals are made, therefore, the depreciation reserve should be charged and the proper plant account credited with the cost of the unit removed. (Illustration III.) The same entries will apply when equipment is removed but not replaced, or when equipment is permanently abandoned as occasionally happens. When equipment is renewed the cost of removing the old units should also be charged to "Depreciation Reserve" and credited directly to "Accounts Payable" and ultimately to "Cash." (Illustration IV.) These entries need not be made through the journal, but should be treated in the same manner as other expense vouchers. The costs of removing the equipment should be met from the amount reserved for depreciation, and these reservations therefore should be great enough to cover the cost of the renewals proper, and the cost of removing the discarded property.

The total cost of the new units in replacement work is debited to "Plant" under the appropriate account in the same way as plant extensions are charged. The credit will be first to "Account Payable," and ultimately to "Cash." (Illustration V.) The cost of a new unit, equal in value to the one removed, being covered by the reservation of past earnings for depreciation, should be paid for from the earnings so reserved. If the cost of the new unit exceeds the cost of the one replaced, such excess must be provided for as are other plant extensions. This must necessarily be, since the allowance for depreciation does not exceed the cost of the unit taken out. When the equipment removed has a scrap value, another entry is required. In determining the amount to be reserved for depreciation it is customary to estimate the life of the equipment, and also its scrap value when taken out of service, such scrap value reducing the sum that must be provided for depreciation. Therefore, the amount that should be charged to the depreciation reserve is the cost new of the unit less its scrap value. This result is obtained by charging the entire original cost of the unit to depreciation reserve account (Illustration I), and then in another entry crediting the Depreciation Reserve account for the scrap value.

The old equipment may be disposed of in various ways. In some instances it is sold as soon as the unit is knocked down, or it may be taken into the store room either to be used again in the business or to be held until sold. Make a debit to "Cash" if the junk is sold, or to "Materials and Supplies" if placed in stock (Illustration VI).

The entries thus far described illustrate conditiions where a Depreciation Reserve only is maintained without a Depreciation Reserve Fund.

In creating a reserve fund as an offset to the depreciation reserve a check should be drawn for the amount involved and debited to the depreciation reserve fund and charged to cash. (Illustration VII.) The presence or use of such fund account will also cause a few changes in the entries required in connection with the removal of old property. These changes consist of substituting the reserve fund account for the cash account in a few instances, as in Illustrations IV, V, VI, because cash affected was transferred from "Cash" account to the reserve account.

Illustration I.—Creation of Depreciation Reserve.—The following journal entry is required monthly for the purpose of providing for depreciation through a charge to operating expenses.

Depreciation. Dr.....
To Depreciation Reserve Cr.....

(Being the proportion charged monthly to operating expenses for depreciation and credited to Depreciation Reserve.)

This entry is identical in wording for both the straight line and sinking fund methods. The only difference is that the amounts under the straight line method would be larger.

Illustration II.—Interest Computation.—Under the sinking fund method the entry for interest computation is as follows:

Interest (Depreciation Reserve Requirement) Dr.....
To Depreciation Reserve Cr.....

(Being the proportiou deducted monthly from gross income for interest under the sinking fund method, and credited to Depreciation Reserve).

Illustration III.—Property Removals Charged to Depreciation Reserve.—When a unit of equipment or a part of the tangible assets has depreciated to such an extent as to necessitate removal, the following entry is made on the journal:

Depreciation Reserve Dr.....
To Property and Plant Cr.....

(Being the reduction of the appropriate property and plant account by the original cost of the equipment removed.)

The entry is illustrative for the removal of any class of equipment, buildings or fixtures.

Illustration IV.—Removal Charges.—Providing all costs were journalized the entries for the costs of removing the property and equipment would be as follows:

(1) Depreciation Reserve Dr.....
To Accounts Payable Cr .....
(2) Accounts Payable Dr.....
To Cash ....Cr.....

Advanced accounting methods require that all costs pass through "Accounts Payable" before affecting "Cash," in order to record expenses, etc., on the accrual rather than on the disbursements basis. In regular practice the above entries would not be made through the journal, but the amounts would be carried directly to the Depreciation Reserve, Accounts Payable and Cash accounts from the records of original entry. This is for the purpose of eliminating much detail work. The accounting principles are the same however, and the result exactly the same.

Illustration V.—Replacement Charges.—When the new unit is installed to replace the unit removed, the following entry will be made if the entries are journalized:

(1) Property and Plant Dr,.....
To Accounts Payable Cr.....
(2) Accounts Payable Dr.....
To Cash Cr.... ....

These entries are journalized for simplicity of illustration. In reg-

ular practice the entries would be made to the accounts affected directly from the records of original entry, such as the voucher, etc., for the purpose of reducing detail work.

Illustration VI.—Entries from Scrap Value.—1. When the junk is sold the following entry is illustrative:

Cash. Dr.....
To Depreciation Reserve. Cr.....

2. When the junk is placed in stock the entry would be as follows:

Materials and Supplies. Dr.....
To Depreciation Reserve. Cr.....

It may be advisable to enter the above transactions on the journal, but is unnecessary. Entry (1) can be made directly in the cash book. Entry (2) can be made on a voucher and posted directly from that source. The above entries, however, are illustrative of the principle.

Illustration VII—Creation of a Depreciation Reserve Fund Account.—To secure the Depreciation Reserve by an actual cash fund, it is necessary that a check be drawn debiting the fund account and crediting the cash for the amount so appropriated. For simplicity in illustrating the entry is shown in journal form, as follows:

Depreciation Reserve Fund. Dr.....
To Cash. Cr.....
(Being the proportion transferred to the fund account to secure a reserve of a like amount.)

Genuine Wrought Iron Pipe.[1]

By Charles Gross.

Sixty years ago the smaller sizes of wrought iron pipe were welded by hand and swedged; and the larger sizes were riveted similarly to the present boiler-making process. To-day, although the actual pipe making is done by automatic machinery, the making of genuine wrought iron is still done largely by hand. Wrought iron is obtained by refining in a puddling furnace the pig iron received from a blast furnace, the operation in the puddling furnace being done entirely by hand. Puddling is one of the very few operations in the iron or steel industry that still await solution by an inventive genius, as no attempts to puddle by means of an automatic machine have so far been sufficiently successful to secure adoption.

To be durable and to fulfil the mission for which it is intended, genuine wrought iron pipe must be tough, fibrous, ductile, resist shocks or vibrations, and have a large factor of immunity to corrosion. In order that it may possess these important essentials the manufacturer must control the quality of the pig iron for its different purposes. Skelp iron, for instance, must be of a strictly neutral iron.

The iron ore as mined is brought to the blast furnace and converted into pig iron. Care has to be exercised in regard to the chemical composition of the pig iron intended for wrought iron. Whatever method may be employed for refining, there is but one object in view, the removal of the carbon, phosphorus, sulphur, surplus silicon and other impurities, by oxidation and combustion. The pig iron is brought to the puddling furnace and remelted. The puddling furnace of to-day does not differ in any way from the puddling furnace of 50 years ago, consisting of a firebox, where the heat is generated, and the hearth where the iron is refined. The heat is generated on the grate, passes through the hearth of the furnace and out to the stack. The puddling furnace has to be prepared for working, which is done by the puddler in the following manner: A certain quantity of iron ore is ground and moistened with water so as to make a plastic mass, which is put up as a lining around the sides and back of the furnace. This is called the "fix," or fixing the furnace, which has the object of furnishing sufficient oxygen to burn up all impurities. It is also done for the no less important purpose of protecting the walls of the furnace. After the fixing, the puddler charges his heat of about 560 pounds of pig iron and then closes the door of the furnace as nearly air-tight as possible; and the heat applied is raised high enough to melt the pig iron. When the melting point has been reached the puddler inserts into the furnace a tool known as a "rabble," with which he thoroughly works the molten metal, breaking up every piece of pig iron that has not melted.

After the metal is thoroughly melted, the puddler commences to feed the iron with the flux, either cinder or scale, a certain amount of which is needed for a charge. During this process the greater part of the impurities are eliminated, some in the form of gases and the rest in a liquid form known as "slag," which runs off over the foreplate. At the end of this process the iron congeals into a semi-plastic mass and the puddler uses a tool called a "paddle," stirring the iron to prevent it forming into lumps, and to break up any lumps that may be in the mass. This process is called "turning" and takes about 15 minutes, when the iron is ready for balling. The heat being made into three balls, the puddler takes each ball separately by means of a pair of tongs suspended from a rail called the "telegraph," which runs from the furnace to the squeezer. The squeezer is a machine having a drum rotating horizontally inside of a horse-shoe curb, with which it forms an alley about 12 to 14 inches wide at the mouth and 7½ to 8 inches at the delivery side. This squeezing forms the iron into a shape of such a nature that the rolls can grasp it, which is called the "bloom." The bloom is rolled down to bars of different widths and thicknesses called "muck bar." The secondary object of the squeezer is to remove by pressure a certain amount of cinder still embedded in the iron.

The muck bar is cut up into lengths and made into piles of the proper width, height and length for the required product. these piles are charged into a heating furnace where they are brought to a glowing white heat or welding temperature. The piles, when intended for pipe, are then rolled into strips or plates called "skelp." The skelp iron is cut in suitable lengths and delivered to the pipe mills.

It is obvious that for such processes, requiring constant attention and much strength only skilled workmen can be employed.

There are two ways of making pipe from the skelp. One is the "butt weld" process, used for smaller sizes, where the edges of the skelp butt against each other; and the other the "lap weld," used on larger sizes, where the edges lap when formed into a tube.

The butt-weld process was originally done by hand by the use of tongs, but now a machine pulls the tongs by a device resembling a bell with the top cut off. This bell is held securely in place in front of a machine known as a drawing bench, on which runs a continuous chain. The skelp having been placed in the welding furnace from one end, the welder on the other end grasps the skelp with a pair of tongs, over which he runs the bell, hooking the tongs to the continuous chain. The skelp is thus pulled through the bell and formed into a tube, being welded at the same time. The pipe is then run through a sizing roll to give it the proper outside dimensions, and then through a set of cross-rolls having the purpose of cleaning and straightening the pipe, next passing to the cooling rack. The cooling rack delivers the pipe into a basket, but before reaching the basket the ends of the pipe are cut off by circular saws on each end of the rack. The pipe is cooled by dipping into a water tank, from which it is taken to the inspection table and then to the threading machines.

The lap-weld process is a totally different procedure, being designed for handling the wide skelp of which large sizes of pipe are made. The skelp is delivered to a charging machine which pushes the plate into a bending furnace. After a plate has been sufficiently heated the charger pushes it out at the other end into a machine known as a "scarfing roll machine," which gives a beveled edge to the hot skelp. A delivery table places the hot skelp in front of the bending die, which is mounted upon a draw bench machine, on which runs a continuous chain. The hot skelp is then grasped by a pair of tongs and pulled through the bending die by the chain, which forms the skelp into a tubular form with one edge overlaping the other, but not welded together. For this purpose the pipe is passed over delivery rails to another charger, which pushes the bent skelp, or so-called "hot skelp," into the welding furnace, where it is brought to a welding heat and pushed through the welding-roll machine. This machine consists of two rolls, one above the other, having a circular groove, forming a nearly circular pass, with its diameter larger than the outside diameter of the pipe being made. Between these two rolls a rod holds a torpedo-shaped body of cast steel, called a ball. The bent skelp passing through the welding rolls is welded by the outer pressure exerted upon the iron by the rolls, and from the inside by the ball. After this operation the skelp has become pipe, the ball falls and the rod is withdrawn from the pipe. The pipe then passes automatically to the so called "blister rolls," which have the purpose of smoothing out the pipe, straightening the ends and solidifying the material. It then passes through the sizing rolls to assure absolute accuracy in outside dimensions, and next to cross-rolls, where the surface of the pipe is smoothed off, freeing it from rough-

1. *Iron Age.*

ness and scale, at the same time being hot straightened. The pipe is then cooled and carried by the cooling rack to the straightening machine, where it is straightened cold, as a slight warping during the cooling process has occurred. All of these rollings of the metal are essential in the making of perfect pipe. Having been straightened while cold, the pipe passes on the inspection table, where the inside and outside defects are discovered, and the good pipe finds its way to a set of rotary cutters, which cut and trim it to the desired length. The pipe is then passed to the scale and weighed, a detail upon which very much importance is laid. Any underweight pipe is rejected at this point, but should it run somewhat heavier than standard weight, the test being a minimum one, the pipe is permitted to go to the shipping room, as its overweight naturally gives it greater value and the purchaser secures the benefit of additional security and efficient service. In this connection it may be stated that for 50 years every length of Byers pipe has been full weight, guaranteed.

The pipe is now delivered to the different threading machines, where it is threaded to Briggs standard gauges, and where the couplings are screwed on. The pipe is then passed to the testing benches, where it is tested to the required hydrostatic pressure. After testing it is again inspected, special care being given to the threads and the couplings. The pipe is weighed again and the length is stenciled on it. The thread protectors are now placed on the end of the pipe to prevent the threads from being damaged while in transit, and the pipe is now ready for shipment or stock.

If to be galvanized pipe, the galvanizing precedes the threading. The galvanizing plant uses the so-called "hot metal" process. The pipe is prepared by removing the scale, grease or any foreign matter from its surface with an agitating device in a bath of diluted sulphuric acid called "pickling." It then is washed with water and immersed in a tank of muriatic acid that gives it the necessary clean surface for the coating of zinc. After drying, the pipe is placed in the galvanizing kettle containing molten zinc or spelter, and then pulled out, cooled in a water tank and inspected. It is now ready for threading. The zinc coats more heavily on genuine wrought-iron pipe than on steel pipe, the porosity of wrought iron being greater. It therefore takes on a greater percentage of spelter, which does not peel as readily as from steel.

The couplings used on genuine wrought-iron pipe are also made of wrought iron. All Byers couplings are rolled couplings, made by a roller-welding machine. The finishing of the coupling consists of facing, reaming, recessing and straight or taper tapping. Great care has to be taken in the finishing operations, as the threads must be smooth and conform to the threads of the pipe.

This careful control of quality in every process of the manufacture of wrought iron pipe is one of the fundamental reasons for its superior durability in use. And the fact that today the highest quality of wrought-iron pipe is made by hand methods that were in vogue fifty years ago is simply because no other methods have been found to equal these old ones for producing a pipe whose texture and flawlessness are up to the old standard of excellence,

Gas or Coal?

[By W. B. STODDARD.]

Why are not gas companies, and dealers in gas fixtures and appliances more alive to the value of their show windows as a means of spreading the gospel of gas as a light and a fuel? A miscellaneous collection of fixtures heaped together in a window attracts no attention whatever from the average passer by, and even the installation of a gas range or fireplace is so conventional as to be but little noticed. What is needed is something novel and at the same time practical—something that will make the throng on the street take notice, and having noticed become impressed with the desirability of placing gas in their own homes.

The Mohawk Gas Company, of Schenectady, N. Y., are using a window display which meets all these requirements, and is noticed by all observers who pass that way. A big sign across the top of the window reads: "Which call do you answer?" In the centre of the show window is a replica of an alarm clock four or five feet in height, made of cardboard. Fastened to the clock is a big red arrow pointing to the hour of six; and a sign on an easel that stands to the left of the clock says: "The housewife who uses a coal range answers the clock at 6 A.M. She rises early because the coal fire is slow in starting and slow in cooking. Breakfast MAY BE ready at 7:30." A large blue arrow points to 7 o'clock, and a sign on an easel to the right says: "The housekeeper who uses a gas range answers the clock at 7 o'clock. She has no fire to build—no coal to carry. She simply lights a match and has a hot fire. Breakfast IS ready at 7:30." Underneath the coal range sign is a big circle of red cardboard on which are placed a bucket of coal, a pile of kindling, a can of kerosene and some matches. Under the gas range sign is a similar circle on which reposes one lone match.

The immense superiority of gas as a fuel strikes home at once, and causes in the minds of the majority who look the desire to instal in their homes this quick and efficacious method of heating. It is a comparison which makes people think, and thinking is the surest prelude to buying.

The Gas Works at Widnes.

So much has appeared in the press regarding the "cheapest gas in the world," made at Widnes, in England, that a description of the plant may be of interest. On the occasion of formal opening of their new works, Mr. Isaac Carr, the Manager for the Municipality, wrote a history of the undertaking, from which the following is abstracted:

Hand stoking at Widnes is being rapidly superseded by improved methods which give a greater yield of gas from the coal, a greater quantity of surplus coke available for sale, and some saving in labor. As a result of inspection of various new types of plant, the writer reported to the Gas and Water Committee recommending the adoption of horizontal retorts and electrically driven stoking machinery, coal and coke-handling plant, as being best suitable, on the grounds of capital outlay being the lowest and the working results, costs and maintenance charges being comparable with those of any other system. Further, the horizontal retort system possesses the very special and valuable advantage of being able to work *any* kind of gas coal, which is impossible with verticals.

The form of horizontal retorts in use at Widnes is one of unusual size, designed by the writer to take an exceptionally heavy charge of coal; so, in fact the retort becomes what may be described as a miniature coke oven. Ordinary retorts ◘ shape, 22 inches by 16 inches by 20 feet, were capable of carbonizing a charge of between 5 and 6 cwts. of coal in six hours. The new retorts, which are built up in segments are ◘ shape, 24 inches by 20 inches by 20 feet, and will carbonize a charge of about 1 ton of coal in 12 hours. The capacity of the old carbonizing plant was about 2,000,000 cubic feet per diem, while the capacity of the new plant is about 3,000,000.

The retort house is a steel-framed building 214 feet long, 62 feet wide, and 47 feet 6 inches high from the clinkering floor level to the eaves. It contains three benches of retorts—two containing four settings each, and the other eight settings, all of eight retorts—in two vertical rows. The furnaces are on Drake's patent tube regenerator principle. The retorts have cast-iron loose sockets, to which the mouthpieces are attached, and the mouthpieces are of the self-sealing type, fitted with special automatic catches. The gas is taken off at both ends of the retorts through 8-inch ascension pipes. The hydraulic mains are 30 inches wide by 24 inches deep, with sloping bottom. The tar outlets are 9 inches diameter, and are connected into a 9-inch diameter tar main leading to the tar towers, which are 30 inches by 15 inches by 19 feet high. The tar main is provided at intervals with cleaning-out holes, and the main is laid with a fall of 2½ inches in 10 feet. The hydraulic mains are divided into sections over each bed, with division plates. The gas outlet from each section is 10 inches diameter, and connections are taken from the gas outlet valves into a 15-inch diameter steel collecting main, which runs down the centre of each bench. These collecting mains are coupled together between the benches into a 20-inch diameter connection, which is taken across the house into a 24-inch diameter foul main. The buckstays on the charging side, which also support the overhead coal-storage hoppers, are 18 by 7-inch rolled steel, and those on the discharging side are 14 by 6-inch. Steel platforms are on the top of the bench, with access ladders from the stage floors. On the discharging side of the house special platforms are arranged to run on rails laid on the floor for inspection and scurfing purposes, and on these rails also run the shoots for supplying the furnaces with hot coke direct from the retorts. The stage floors are of concrete arches sprung between logitudinal lines of steel girders, paved on top.

The coal wagons run through the coal store and are tipped by an electrically-driven end tipper into a coal-receiving hopper, from

which the coal is fed by means of an automatic screening feed either to the coal breaker or direct into the elevator boot. The tipper has an auxiliary barrel for hauling the wagons. The coal breaker, elevator and conveyor will handle 30 to 35 tons of coal per hour. The coal is delivered from the elevator to a push-plate conveyor running over the storage hoppers. The breaker, elevator and conveyor are driven by separate 12 horse-power motors. The overhead coal-storage hoppers hold sufficient coal for forty-eight hours' supply, working at full capacity. The hoppers are fitted with Aldridge and Gibson's patent doors, operated by the stoking machine, and have coal shoots for delivering any surplus coal from the hoppers back to the coal store. The stoking machine is a Fiddes-Aldrich simultaneous charger-discharger, and the complete operation for a retort in many instances does not take more than one minute, and is frequently done in less time.

The electrical power generating plant is in duplicate, each dynamo giving a continuous output of 50 kilowatts 225 volts, direct current, and are coupled by flexible couplings to 95 brake horse-power gas engines running at 210 revolutions per minute, the engines being fitted with magneto ignition and hand-pump starter.

The coke conveying plant is a high speed, mono rail, telpher system, having travelling speed of 500 feet per minute. The gross lifting capacity of the telphers is 45 cwts. at a speed of 50 feet per minute. The hoist is of the direct lifting type, with 2 cast iron barrels grooved for 2¼-inch circumference ropes. The two ropes hang direct from the lifting barrels, the lower ends being connected to the skip and bale in such a way that they may be readily detached and the worn or burned ends removed. In dealing with hot coke this provision has been found to be of much service. There are two sets of skips, deep skips having a hot coke capacity of 110 cubic feet, and shallow skips, for the bottom retorts, with a capacity of 68 cubic feet. The telpher track is 14 by 6-inch steel beams, with flat bottom bulb rail 28 pounds per yard, and about 1,080 feet long, with a branch line used for handling ashes, etc. The trestles are about 42 feet high, of 12 by 5 inch steel beams.

At each end of the retort house is a cast-iron tank for quenching the coke, 14 feet long by 8 feet wide by 5 feet deep, and provided with an arrangement of doors, so that when the skip is lowered into the tanks the doors automatically close and prevent escape of steam during the quenching of the coke.

On the outside track, inclined screens are fixed directly under the path of the coke skips, to deliver coke direct into railway cars.

The following table shows the progress of Widness to the proud position it now holds.

Year	Total Gas made in thousands Cu. Ft.	Capital Per million Cubic Feet Gross £	Capital Per million Cubic Feet Net £	Net Selling Prices of Gas within Borough Per 1,000 Cubic Feet Ordinary.		Prices of Gas to Automatic Slot Consumers.	Total Number of Consumers.
1867	13,000	....	....	....	....	3/9	....	....
1882	62,000	944	899	....	....	3/6	....	700
1883	64,598	933	879	2/9	3/	3/6	....	....
1884	69,302	954	897	....	....	3/3	....	....
1885	76,670	847	783	2/3	2/6	2/9	....	....
1887	86,147	759	686	2/	2/3	2/6	....	....
1889	111,958	567	501	1/10	....	2/	....	....
1894	150,383	534	436	1/6	....	1/8	....	....
1895	172,464	502	412	....	....	....	2/9	....
1898	202,307	508	362	1/5	....	1/6	....	....
1899	209,372	496	356	....	....	....	2/4	....
1900	223,630	474	335	1/3	....	1/5	2/2½	5,895
1901	214,520	443	314	1/1	1/3	1/5	....	6,231
1904	288,235	382	263	1/	1/2	1/4	2/1	6,001
1906	295,000	414	284	11d.	1/1	1/3	....	6,347
1907	323,412	415	292	....	..	....	1/10½	6,664
1909	363,954	384	268	10d.	1/	1/2	1/8	7,285
1911	403,020	354	246	9d.	11d.	1/1	....	7,670
1912	421,390	346	234	....	...	1/6½	....	7,705
1913	456,521	307	207	....	....	....	....	7,830
1914	502,421	373	273	8d.	10d.	1/	1/4½	7,940

Results for 18 weeks, during which the new plant has been in operation as distinct from the old plant, are as follows:

Gas made per ton of coal, 12,500 cubic feet.
Average illuminating power, 17.8 candles.
Average calorific value, 610 B.T.U.
Wages per ton, including coal from store to coke in yard, including foremen, 10d.
Wages per ton, excluding foremen, 7¾d.
Surplus coke per ton of coal carbonized, about 12 cwts.

The contract price for the 3,000,000 cubic feet plant, exclusive of land, excavations and foundations, was £29,360, to which must be added £1,500 for the extension of the telpher track, patent coke quencing tank, and spare parts for the electric plant and other machinery. The total cost of the whole will be about £40,000, including railway sidings, new condensers, coal store roof, 20-inch station governor and connections, provision of new mains and alterations to existing mains, and the cost of dismantling the old plant.

With £40,000 added to the existing debt on the department, the capital per million cubic feet of gas sold is £272 net compared with £899 net per million cubic feet at the time of Mr. Carr's appointment in 1882.

Electric Water Heaters.[1]

By Mr. E. F. Carpenter.

Electric heaters for the heating of water should preferably be of the immersion type, because when the heater is completely immersed it gives practically all its heat to the liquid, and is very nearly 100 per cent. efficient, the only loss being the heat given to the air by the liquid. For this reason what are called immersion discs, or immersion bayonet heaters, Fig. 1, should be used. Disc heaters are constructed of a slotted ribbon heating element, wound on a mica sheet, with mica sheets to insulate it from the metal disc casing. The leads are continuations of the ribbon element, mica insulated, and connected to terminals in the handle where the cord is attached. Bayonet heater elements are also of the slotted ribbon type, mica insulated and assembled in long seamless copper tubes or bayonets. All joints and seams are brazed so that they will be no more subject to damage by heat than the sheet metal itself. These types are of the simplest, and all odd and freak shapes should be avoided, as they are generally both mechanically and electrically weak.

This disc type immersion heater, which gives a range of from 125 to 1,100 watts, will be found satisfactory for practically all smaller applications. such as in restaurants, barber shops, soda fountains, offices, kitchens, laboratories, dental parlors, hospitals, and surgical operating rooms. It can also be used in manufacturing processes requiring heating of small quantities of water, oils, glues, waxes, inks, glucose and the like.

The bayonet type immersion heater has a very wide field, being applicable to many similar uses. It is the most efficient and satisfactory heater yet produced for water and steam sterilizers for hospital use. When applied to the common hot water boiler or storage tanks in the home, ranging from 20 to 40 gallons capacity; and larger storage tanks in manufacturing plants, office buildings, railroad stations, conservatories, apartment buildings, hotels, natoriums, laundries, etc., they are found to be very efficient and satisfactory. This method of heating finds favor due to its convenience and reliability, and on account of its being much more sanitary and healthful than any other method of heating. Bayonet immersion heaters are a great help where gas is not available, where other fuels are undesirable, and in many cases where a manufacturing process requires the use of a small amount of hot water or steam.

Table 1 gives information which it is believed will be of considerable value. Radiation losses are based on 2 inches of asbestos or magnesia lagging, but no radiation losses from the pipes of the connecting system have been included. Computations are made at 100 per cent. efficiency, so that allowance should be made for conditions of each application.

For office buildings and hot water installations of like character, the storage capacity is generally about one-fourth the maximum demand, and the heating capacity is made equal to the maximum demand. For homes and apartment houses the storage capacity should be about one-half the maximum demand, and the heating capacity about 75 per cent. of the maximum demand.

The following example will show a method by which an idea can be gained as to what a tank of a given capacity, heated to a certain temperature will do in furnishing hot water for bath purposes:

	B. T. U.
30 gal. + 8.34 lbs. × 160° +	40,600
30 gal. + 8.34 lbs. × 100° =	25,000
Difference,	15,600

1 "The Electric Journal."

(*Continued on page* 90.)

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NOTICE TO ADVERTISERS.

New Advertisements and changes of copy therefor should be in hand Wednesday noon of week prior to date of issue.

NEW YORK, MONDAY, AUGUST 10, 1914.

[Official Notice.]

New Jersey State Gas Association.

Office of the Secretary,
Broad and Bank streets, Newark, N. J.,
July 21, 1914.

The next meeting of the New Jersey State Gas Association will be held at Wardell's, Port-au-Peck, on Pleasure Bay, Wednesday, Aug. 12, 1914. The meeting will convene at 10 A.M,, and the following papers will be read and discussed:

"Development and Possibilities of Gas Water Heating," by Mr. Herbert Long, of Long-Landreth Company, New Brunswick, N. J.

"Newest Things in Gas Lighting," by Mr. F. N. Hamerstrom, of the Welsbach Company, Gloucester, N. J., and Mr. J. P. Conroy, of the General Gas Light Company, New York city.

"Auxiliary Heating," by Mr. William Schofield, of the Sanitary Heating Company, Brooklyn, N. Y.

The session will continue until 2 P.M., at which time a clam bake will be served. This "Bake" is an annual event of the New Jersey State Gas Association, and the chef preparing it is famous throughout this part of the country.

Is is expected that every member of the Association will be present and that many guests will also enjoy the hospitality of the Association.

Wardell's can be reached via. P. R. R. or C. R. R. of N. J., to Long Branch, thence by trolley to Pleasure Bay.

O. F. Potter, Secy.

[Official Notice.]

Michigan Gas Association Meeting.

Office of the Secretary-Treasurer,
Grand Rapids, Mich., June 29, 1914.

The annual meeting of the Michigan Gas Association will be held at Lake Harbor, Wednesday, Thursday and Friday, September 2, 3 and 4. This decision has just been made by the Executive Committee of the Association and we are sure those attending the meeting will find this departure from the regular practice of holding gas association meetings in the large cities, a most delightful experience.

Lake Harbor is a resort beautifully located on Lake Michigan and an inland lake 4 miles south of Muskegon, Mich. It is reached by Goodrich Boat Line via Muskegon, and by the Grand Rapids and Indiana Railway, and the Grand Rapids-Muskegon Electric Road via Grand Rapids. The hotel accommodates 500 guests, is prettily located and gives excellent service. There is a fine 18 hole golf course, baseball grounds, 9 tennis courts, Lake Michigan bathing beach, fine bath houses, bowling alley, billiards, canoeing and good automobile roads. There is a combination theater and convention hall which may be used for dancing parties as well as for the business sessions of the convention.

There are a number of cottages in connection with the hotel, and it is hoped that members will bring their wives and children, for the resort specially caters to the whole family.

At the time chosen, the association will have the resort practically to itself, and there is enough to do aside from a carefully planned business programme, which will be announced later, to make the trip worth while to any gas man within reachable distance of Michigan. Every gas man is invited to meet with us whether a member of the association or not. The hotel rates are on the American plan ranging from $3 a day without bath, to $4 and $5 a day with bath; and will for this occasion cover the use of the golf course, tennis courts and other features for which there is usually an additional charge. Glenn R. Chamberlain, Secy. Treas.

BRIEFLY TOLD.

Gas Manufacture in Rhode Island.—In its annual report to the Governor, the Public Utilities Commission of Rhode Island gives this information regarding the gas industry in the State:

"The Commission at the beginning of the year secured the services of Mr. Edmund Cathels, a gas engineer of large experience, and he has been engaged in making tests of the quality and pressure of the gas sold by companies in the State. Upon the recommendation of its engineer, it fixed the fees for testing gas meters and ordered that a meter should be considered correct, if when passing gas at the rate of 6 cubic feet per hour, per light capacity, under a pressure of 2 inches of water, it shows, in comparison with a standard gas prover, an error not greater than 2 per cent. Three meter tests applications were received and in one case the meter was found to vary more than permitted.

The matter of regulating the manufacture of gas has been given some consideration by the Commission, but no regulations have as yet been adopted. Gas manufactured and supplied in the State is coal gas and carburetted water gas; Providence Gas Company and Newport Gas Company using both methods, their commercial product being a mixed gas. The other companies operate carburetted water gas processes. The Providence Gas Company is making coal gas in vertical retorts, a quite recent invention, considered to have some advantage over horizontal retorts. The carburetted water gas is made by what is known as the Lowe process, the generally accepted method of manufacturing this gas. The proportion in the mixed gas is about half and half. Newport Gas Company makes coal gas in horizontal retorts, and carburetted water gas by the usual method.

The carburetted water gas process has many advantages that are impossible of attainment in a coal gas process. The rapidity and ease with which gas can be made, and its flexibility of operation makes it a very desirable process of manufacture; but the rapid increase in the price of gas oil used in this process, is considerably checking its extension and curtailing the use of apparatus already installed.

The Pawtucket Division of the Blackstone Valley Gas and Electric Company has in contemplation the installation of a coal gas process of the vertical retort type, which is considered one of the latest improvements in this type. Its main feature is that it is continuous process, coal being fed into the top of the retort and coke discharged from the bottom, both in a continuous and automatic manner. It also has the advantage that there is no smoke or steam noticeable, and dust is reduced to a minimum, making the surrounding and the operation more pleasant than under other and older methods.

Gas is supplied to Woonsocket from Pawtucket, as are all intermediate localities between these two cities. The gas is delivered into the Woonsocket gas plant at 30 pounds pressure, and from there distributed under normal pressures. As previously stated, Westerly, Bristol and Warren are supplied with carburetted water gas, while Tiverton is supplied by the Tiverton Gas Company, with gas made in Fall River, Mass. Gas pressures have been tested and recorded in various districts, the highest pressure being recorded in Providence, a maximum of 8 inches and a minimum of 4 inches. The lowest pressure recorded is in Newport showing $1\frac{6}{10}$ and maximum $2\frac{8}{10}$.

Periodical tests of the illuminating power of gas in Providence, Pawtucket and Woonsocket have also been taken, the maximum of Providence gas being 19.4 candles, the lowest, 15.1, and the average of nine tests, 16.7 candles. Pawtucket and Woonsocket both show an average of 20.7, while Newport gives an average of 16.35 for six tests, the highest being 17.77, and the lowest, 14.83 candles.

Only three companies are provided with calorimeters, viz.: Providence Gas Company, Blackstone Valley Gas and Electric Company,

Pawtucket and Woodsocket Divisions; and all are of the Junker's type. Periodical tests were made with the following results: Providence highest 646 B. T. U. per cubic foot of gas, lowest 606 and mean 624. Pawtucket, highest 594 B. T. U., lowest, 592, and mean, 593. Woonsocket highest, 594 B. T. U., lowest, 592, and mean, 593.

OUR MINERAL PRODUCTS.—Secretary of the Interior Lane considers the Nation's output of mineral products of various kinds is a fair measure of our general industrial activity. For several months now the Department of the Interior, through the Geological Survey, has been issuing its final statistics of the 1913 mineral production, which confirm in detail the preliminary estimates for the principal minerals issued early in January. In one way or another these authoratative figures tell the same story of industrial prosperity. In coal production the increase has been general, and this one fact is an unmistakable index of general health in the industrial world. But as State after State is shown to have had its banner year—West Virginia, Illinois, Ohio, Kentucky, Alabama, Virginia, Oklahoma, New Mexico, Montana, Texas, Utah, and Pennsylvania, in both bituminous and anthracite, the record becomes spectacular. Ohio for instance, had floods, yet there was a substantial 6 per cent. increase in coal output, and the miners averaged more working days in 1913 than in 1912. Twelve other states showed increases varying from 3 per cent. in Iowa to 12 per cent. in Indiana and over 13 per cent. in Washington; and only Colorado, Maryland, North Dakota, Nevada, Idaho and Missouri show decreased output, the Colorado labor troubles explaining the only significant decrease. In a similar way, the figures of coke production give large increases, especially noticeable in by-product oven coke, and coke, it may be noted, is a step nearer the metal industry. Petroleum production in 1913 exceeded all records, an increase of 25,000,000 barrels and $75,000,000 over the 1912 returns. In metal mining, iron and zinc had a banner year; but gold, silver, lead and copper showed a decline in many of the largest producing States. Structural materials on the other hand exhibit marked gains, almost more than 11 per cent. over 1912, and record outputs are also shown for lime, building sand and gravel, sand-lime brick, and glass sand. Other mineral products for which 1913 was a record breaking year, are bauxite and aluminum, sulphuric acid, feldspar, mica, pottery and talc and soapstone, while substantial increases are reported for gypsum, phosphate rock, abrasives, barytes, slate and salt. These production figures express well-maintained activity in mines, smelter, furnace and mill; and prove that the American people are utilizing more of the Nation's great natural resources than ever before. The gas fraternity is helping to more efficient utilization in many directions.

FIRE-PLACE DESIGN COMPETITION.—The Joint Committee of the American Gas Institute and the National Commercial Gas Association on "Fire-Place Heater Design" offer a prize of $150 for the best design submitted to them for a fire-place heater burning gas.

While there are several types of heaters on the market which are fairly satisfactory heat producers, they do not meet the requirements from the standpoint of appearance. The Committee wants a heater that may be placed in the open fire place of the library, living-room or dining-room of an artistically furnished dwelling, that will be appropriate for the purpose, and artistically consistent with the furnishings. The appearance when unlighted, is of equal importance with the appearance lighted, and, in awarding the prize, these two features will be given equal value. Most of the heaters now made are either palpable imitations, like gas logs, or are of such shapes, or composed of materials that give them a cheap appearance, not in keeping with the modern domestic interior. Some fire-place heaters made in England, suggest a possible solution better than anything that has been manufactured in this country.

The Committee realizes that the draftsmen likely to enter this competition have probably but a slight knowledge of the principles of gas combustion; and that the inherent difficulty in the problem is to obtain a design satisfactory in appearance when unlighted and when lighted, and which will at the same time permit of proper combustion of the gas, and be efficient in the radiation of heat. It may be said, however, that gas burners can be made in almost any shape, and that it is, generally speaking, possible to reconcile an adequate handling of the gas with a wide variety of designs of heaters. It is, therefore, suggested that the first thought should be given to the production of a design artistically appropriate when the heater is unlighted, it being assumed that the technical requirements may be afterwards met by the engineers of the Committee.

As a guide to the contestants, the following technical facts are given: The burners may be of either the illuminating type, or of the atmospheric type. In the former, there is always a certain amount of flicker in the flame, and the flame must not be allowed to come in contact with metal or other material, but must burn freely into the atmosphere. In atmospheric burners the gas flame has no illuminating value, and the flame may be allowed to touch metal or other material, without danger of depositing carbon. Contact of the flame with other material is generally accompanied by the emission of some odor, but it is the intention to have the products of combustion from these gas fires taken-off through a flue.

The principal heat giving requirement is, that as much as possible of the heat generated by the gas combustion, shall be emitted in the form of radiant heat. The yellow flames of illuminating burners radiate considerable heat, but the blue flames from atmospheric burners radiate very little heat. Their usefulness depending on their ability to make hot some material composing the heater, which is a good radiator. On this same principle heat is radiated from the hot ashes, fire brick floor and back of a fire-place with a wood fire. The gas log is an excellent radiator. The surface of the log, composed of iron or of mastic material, is heated by the small gas flames, and these materials are excellent heat radiators.

Contestants will be given pictures of several of the ordinary forms of gas fireplace heaters now on the market, including a few English designs. Examples of these types may be seen at the office of Mr. O. H. Fogg, Engineer of Utilization of the Consolidated Gas Copmany, 128 East 15th Street, New York city; or in the office of Mr. Geo. S. Barrows, The U. G. I. Building, Broad and Arch Streets, Philadelphia. Further information regarding technical conditions may be obtained by application to either of the offices named.

POLITICAL OPERATION.—In an address to the Ohio Electric Light Association, Mr. H. J. Gordon, publisher of "*Public Service*," Chicago, said: Municipal ownersbip is generally a misuomer, for the plants are usually bonded, and hence the profit is called interest. What is now designated municipal ownership should be styled individual ownership under political management. Basing his talk on data obtained in 18 municipally owned Ohio plants, Mr. Gordon declared that misrepresentation and deceit practiced on the public by city officials were the rule rather than the exception, for no official will admit the occurrence of a economic loss under his administration. All of these 18 plants made incomplete and misleading reports, and analysis of the true conditions shows that every one was losing money. An average of their deficiencies showed that as a whole the rates of these plants ought to have been raised about 100 per cent. Instead, however, the trend of rates is downward. One interesting and helpful idea suggested at this meeting was that of "renting" salesmen from one company to another. Mr. D. L. Haskill, Greenville, said he had at one time secured a man from Columbus, and at an expense of only $25 had obtained a 400-horse power motor service contract. Mr. Wolls said that he thought all of the larger companies stood ready to give similar aid to their smaller neighbors. The question of hiring a man to do special work for several small companies, brought up by Mr. T. F. Kelly, Dayton, was also discussed, but the "renting" idea seemed best to fit present needs.

This suggestion is in line with the move contemplated by the National Commercial Gas Association, who plan to employ an industrial gas expert whose services will be available for all member companies on a per diem fee.

WORKMEN'S COMPENSATION DIFFICULTY.—Public service corporations of Iowa have appealed to the State industrial commissioner for relief from a situation that has arisen under the workmen's compensation law that became effective July 1. Insurance companies have refused to insure aged and partially disabled employees, declaring the risk too great. The Iowa law forbids the employer suggesting to the employee that he reject the compensation act, but provides that if the employee rejects the act, the same relation of master and servant exists as did before the law went into effect. The public service companies would retain all employees who will reject the statute, but if the industrial commission cannot find a way by which the employers can make such an offer to employees, the aged and crippled will lose their positions. Many public service corporations, especially electric and street railway companies, have required physical tests of all employees. Hundreds of men will be compelled to quit unless they reject the compensation act.

(Continued from page 87.)

TABLE 1.—*General Heating Data.*

Tank Capacity, Gallons.	Tank Length, Feet.	Tank Diameter, Inches.	Water Contents, Pounds.	Watts Radiation Loss per Hour. Temp. Diff. 100°.	Watts Input to Raise Metal Tank, 100° in 1 Hour	Watts Input to Raise Water only, 100° in 1 Hour.	Total kw. input required to supply radiation losses and raise temperatures of tank and water from 60° to 160° in 1 Hour.	2 Hours.	3 Hours.	5 Hours.
12	3	10	100	125.	158.	2920.	3.14	1.60	1.08	.678
17	2.8	12	142	154.	193.	4140.	4.41	2.24	1.52	.944
18	3	12	150	161.	201.	4380.	4.66	2.37	1.61	.996
21	3.5	12	175	183.	229.	5120.	5.44	2.77	1.87	1.162
24	4	12	200	205.	253.	5840.	6.20	3.15	2.13	1.321
28	3.5	14	233	220.	285.	6820.	7.22	3.66	2.44	1.531
30	3	16	250	227.	317.	7310.	7.74	3.93	2.66	1.638
32	4	14	267	249.	324.	7796.	8.24	4.18	2.83	1.748
35	5	13	292	278.	348.	8520.	9.00	4.57	3.10	1.913
36	4.5	14	300	271.	359.	8770.	9.26	4.70	3.18	1.961
40	5	14	333	300.	377.	9730.	10.26	5.21	3.52	2.17
42	4	16	350	286.	412.	10220.	10.77	5.46	3.69	2 27
48	6	14	400	352.	465.	11680.	12.32	0.25	4.23	2.61
53	4	18	442	330.	522.	12900.	13.59	6.88	4.64	2.85
63	6	15	525	411.	705.	15330.	16.24	8.22	5.55	3.41
66	5	18	550	396.	880.	16050.	17.13	8.66	5.84	3 58
79	6	18	658	468.	915.	19210.	20.36	10.30	6.94	4.26
82	5	20	684	447.	968.	19940.	21.13	10.65	7.19	4.41
85	5	20	708	447.	1020.	20680.	21.92	11.07	7.46	4.56
100	5	22	834	498.	1056.	24330.	25.64	12.94	8.71	5 33
120	5	24	1,000	557.	1232.	29200.	30.71	15.49	10.42	6 36
140	6	24	1,168	645.	1408.	34300.	36.03	18.18	12.22	7.46
150	4	30	1,250	608.	1480.	36510.	38.39	19.30	12.97	7.90
168	7	24	1,400	740.	1654.	40880.	42.90	21.64	14.55	8.88
180	5	30	1,500	712.	1690.	43800.	45.85	23.10	15.52	9 45
192	8	24	1,600	828.	1900.	46720.	49.16	24.79	16.66	10.26
220	6	30	1,835	835.	2025.	53290.	55.61	28.01	18.81	11.46
250	7	30	2,082	953.	2110.	60830.	63.42	31.95	21.46	13.06
300	8	30	2,460	1062.	2325.	71780.	74.64	37.58	25.23	15.35
315	6	36	2,626	1033.	3415.	76650.	80.53	40.55	27.20	16.43
365	7	36	3,044	1172.	3800.	88820.	93.21	46.90	31.46	19 11
420	8	36	3,500	1312.	3170.	102200.	106.00	52.85	35.12	20.93
430	6	42	3,588	1246.	3134.	105200.	108 96	54.79	36.74	22.30
500	7	42	4,172	1415.	3520.	122300.	126.53	62.62	42.65	25.87

One gallon of cold water at 60° requires 8.34 lbs. × 40°
or 334 B.T.U. to be raised to 100° 15,600 + 334 = 47

or 47 gallons of cold water at 60° when mixed with 30 gallons of water at 160° will give 77 gallons of water at 100°, and as 20 to 25 gallons is sufficient for the average bath, enough warm water is obtained for three baths.

Fig. 1.—Bayonet Type Heater with and without Casing.

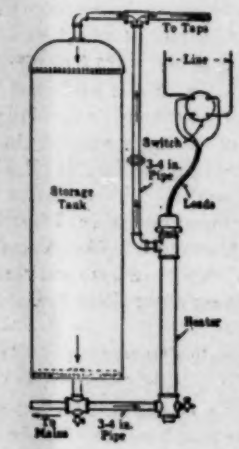


Fig. 2.—Storage Tank Installation.

Instantaneous water heating should ordinarily not be attempted with bayonet heaters. If it is necessary, however, the use of the empirical formula

$$\frac{146 + \text{gal.} + (T, + T_1)}{\text{watts} \div \text{per cent. efficiency}} = \text{minutes},$$

will show that 10,500 watts will heat 30 gallons of water, from 60° to 100° in about 19 minutes, which means that the water may flow from the faucet at about the rate of 1.5 gallons per minute. The bayonet heater should be so installed in the system that cold water is drawn from the bottom of the tank through the heater and returned to the top of the tank heated to nearly the maximum required temperature, (Fig. 2) so that hot water may be drawn from the top of the tank shortly after the heater is turned on. In cases where other reasons make it advisable, the bayonet heater may be inserted through the bottom or side of the tank, so that the whole mass will be raised to the required temperature.

Where the cost of current is low, say from 2 cents down to 0.5 cent per kw-hr., electricity can compete with other forms of heat, and there is an immense field for these types of heaters. Central stations which are in a position to make low rates for this class of heating are beginning to appreciate the value of this load on their lines in giving them a better load factor.

The Heat Treatment of Carbon Steel.[1]

[From a paper by H. P. TIEMANN, read before the Technology Club of Syracuse, N. Y.]

In this paper I have considered only pure carbon steel; that is, the alloys of iron with carbon. The principles involved are practically the same as when other elements are present, but certain exceptions are thus avoided which render the subject more difficult of comprehension.

Heat treatment in its more general sense may be taken to mean the application of heat either to make the metal easier to work by rendering it softer or more ductile, or to secure certain desired changes in its constitution and physical properties; but, by common usage, the term is restricted to the latter application, for which the writer has suggested the following definition:

Heat treatment is the change or the series of changes in temperature, and also the rate of change from one temperature to another, brought about to secure certain desired conditions or properties in a metal or alloy.

1. Slightly abridged.—EDS.

The explanation of the various changes brought about by heat treatments is based on the theory that the element iron under proper conditions is capable of three, or at least two, allotropic modifications whereby certain of its properties differ considerably. To illustrate this it will be sufficient to cite the case of steel of a grade suitable for hardening. This can be effected by rapid cooling (usually quenching) only when heated above a certain definite temperature. At any lower temperature, no matter how rapid the cooling, it will remain soft. This is due to an allotropic modification existing above the given temperature which, by the rapid cooling, is preserved either partially or wholly in the cold state. If this were not so, the hardness should increase gradually when cooled from progressively higher temperatures. In order to understand how heat treatment can produce such changes, it is necessary to consider how steel is constituted or made up under different conditions of treatment or composition. Iron the element is only a metallurgical curiosity, as its cost is very high. Its practical application is relatively limited in comparison with that of its combinations, which are capable of widely varying properties for all manner of purposes. Such a combination is commonly known as an alloy, even if the other ingredients are not metallic. The most important element to combine with iron is carbon, the resultant substance (with carbon up to about 2 per cent.) being termed steel. Carbon has a wider effect on iron than any other element, and even when chromium, nickel, vanadium, etc., are introduced its influence still predominates. As the iron-carbon alloys present certain complications, it will be simpler to approach the subject by a study of what occurs when solutions containing different proportions of water and salt are cooled. If pure water is cooled, its temperature falls regularly until 0° C. is reached, when freezing occurs, the temperature remaining constant until all the water has frozen, after which the fall of temperature proceeds regularly. If a solution of 2 per cent. of salt is cooled, freezing does not take place until below 0° C., and the entire solution does not freeze. Instead, small portions of nearly pure ice are gradually formed as the temperature is progressively reduced, the remaining solution becoming richer and richer in salt. Finally at —22° C. the temperature remains stationary until the remaining solution, which now contains 23.6 per cent. of salt, has solidified. This last freezing substance consists, not of crystals of salt dissolved in ice, but of separate, intimately mixed, microscopic plates of ice and salt. Such a mixture is termed a "eutectic" or "cryohydrate."

With 10 per cent. of salt cooling proceeds to a lower temperature before ice commences to separate out; but the final freezing point and the composition of the mother liquor are again —22° C. and 23.6 per cent. of salt, there being of course more mother liquor. If more than 23.6 per cent. of salt is in the original solution, then salt, instead of ice, separates out initially, so that at —22° C. this composition is reached. No matter what the initial percentage of salt, the final composition at —22° C. is the same.

Where retardations in the rate of cooling occur, due to freezing of part or all of the constituents, the temperatures are termed "critical" points or temperatures. A curve for any composition, plotted to show the rate of cooling, is termed a "cooling curve"; a curve comprising the critical points of a series of compositions is known as a "freezing point curve."

As the changes in the constitution of steel which heat treatment effects occur after the metal has solidified, it will not be necessary to consider here how it arrives in this condition. It may at first be difficult to grasp the idea of changes occurring in solid material, but a little thought will show that the principal difference between a solid and a liquid is in the degree of mobility of the particles or molecules. From water, as one extreme, whose particles are highly mobile, to a heavy oil, then, say, to molasses, then to highly heated steel which is readily forged and rolled, and finally to the same metal when cold (which can still be worked to a considerable extent, as in wire-drawing) as the other extreme, the steps are relatively gradual. We therefore properly speak of a "solid solution," in which the degree of viscosity is high, as similar to a liquid solution, such as the salt and water, in which the particles have great freedom of movement.

Fig. 1, known as the "iron carbon diagram," is based on the work of various investigators and shows the normal conditions which various iron-carbon alloys assume at different temperatures, as indicated by the areas, the boundary lines showing critical temperatures in passing above or below which changes in condition occur. These transformations are not instantaneous, but require time for their completion owing to the lag or inertia (molecular viscosity) of the metal. Even with very slow changes of temperature some lag is always present, being more marked when considerable amounts of carbon are present, and for this reason the position of the lines must be slightly lowered if cooling phenomena are being considered, and similarly raised (but to a less extent) for heating.

The various conditions in which iron-carbon alloys may exist, depending upon the temperature and the percentage of carbon, constitute what are really different substances possessed of different characteristics. To distinguish them names have been given, based on methods of nomenclature employed for chemical compounds. For the present purpose it will be sufficient to consider only that portion of the diagram comprising carbon up to about 1 per cent. and for temperatures not exceeding 1100° to 1200° C.

The element iron has the peculiarity of possessing different properties which are normal in different ranges of temperature, a phenomena known as allotropy. Three allotropic varieties or modifications are generally recognized. (See Fig. 1.)

Alpha iron, which is normal below M O S; *beta iron*, normal in area G O M for steel with carbon up to about 0.35 per cent; and *gamma iron*, normal above P S,

Gamma iron can dissolve carbon (as a solid solution) up to about 1.7 per cent.; is intermediate in hardness between beta and alpha iron; is non-magnetic. *Beta iron* (whose existence is still in dispute) can probably dissolve some carbon; is very hard; is weakly magnetic. *Alpha iron* can dissolve little if any carbon; is soft; and is strongly magnetic.

If pure iron (ferrite) is cooled from, say 1,200° C., where it exists as gamma iron, the rate of cooling is regular until the point G on line G O S is reached, when a retardation (Ar_3) occurs, due to the transformation from the gamma to the beta condition. The rate is then regular until tho point M on the line M O is reached, when a second retardation (Ar_2) is observed from the transformation into alpha iron. With pure iron only there is no retardation at the line P S, the rate of cooling becoming regular after passing M.

If there is a small percentage of carbon, say 0.20 per cent., a somewhat different state of affairs is found at high temperatures. This carbon, either as such or in the form of carbide of iron (Fe_3C), is in solid solution in gamma iron, which is normal at this temperature, this solid solution being termed *austenite*. When the temperature passes the line G O (Ar_3), free iron in the beta condition is progressively expelled from the solid solution until the line M O (Ar_2) is reached. This beta iron is then transformed into the alpha condition, the expulsion of free iron (also in the alpha condition) continuing until the line P S (Ar_1) is reached. At this point the austenite has been decreased in amount to such an extent that its carbon content has reached the eutectoid percentage (about 0.85 per cent.), that is, what is contained in pearlite. After passing this temperature the remaining austenite is transformed into pearlite, the gamma iron having been changed into alpha iron, whereby the carbon in solution is thrown out as carbide of iron (cementite). The final result is consequently pearlite and free ferrite.

With, say, 0.50 per cent. carbon the same phenomena occur, except that there are only two transformation points, the two upper points previously found being now merged in one (Ar_{3-2}) when the line O S is reached. Also there is no formation of beta iron, the excess iron separating out in the alpha condition between the line O S and P S until, when P S (Ar_1) is reached, the remaining austenite has the eutectoid percentage of carbon as before.

With about 0.85 per cent. to 0.90 per cent. carbon, there is only one transformation point at S (Ar_{3-2-1}), as in this case, there is no need to separate any iron from the austenite to bring it to the eutectoid composition.

With higher carbons, when the line S E is reached, there is a separation of cementite (instead of iron) until at the line S K the austenite is again of eutectoid composition. Below this line the normal constitution of the metal is pearlite and free cementite.

That carbon is the element which governs or controls the physical properties of iron appears to be due to: 1. Its condition; 2. Its distribution. The carbon may be in solution in gamma iron, or in combination with iron as the carbide, if the rest of the iron is in the alpha state. If the carbon is in solution it must be completely diffused or merged in the iron in the same way that salt is diffused when dissolved in water, forming one homogeneous substance, in which individual particles cannot be detected, even by the aid of the most powerful microscope. If this solid solution of iron and carbon is preserved cold by sufficent rapid cooling, the complete diffusion must also be preserved. By reheating the temperatures inferior to

Ac_1, the restrain of the atoms is sufficiently removed to permit the transformation of some or all of the gamma iron into alpha iron. The carbon originally in solution in this portion is thereby automat ically expelled as cementite, resulting in the formation of pearlite. Unless the temperature is close to Ac, there is still too much viscosity to permit the molecules sufficient freedom of movement to cause any marked segregation of the ferrite and cementite, so the pearlite has an extremely fine structure. Where temperature and time of cooling are sufficent relatively coarse pearlite will form. The segregation is not what is commonly understood by the term, and which can be detected by chemical analysis, but only in a miscroscopical sense.

In actual practice if two pieces of the same steel, one merely annealed while the other is quenched and then reheated below Ac_1, the latter will possess considerably better strength and ductility. The cause of this is in distribution of the carbon, that is, the material is microscopically more homogeneous.

Metals and alloys are composed of crystals or grains. The irregularity of their form is due to the fact that the growth of each is interfered with by that of the others surrounding it. Therefore, it is only under special conditions that perfect crystals form. The size of these grains depend upon the maximum temperature above Ac_1, at which they have been free to develop, subject to the following conditions:

If a piece of steel is heated to a temperature corresponding to the point *G* in Fig 2 and then cooled it will have a grain size O L pro-

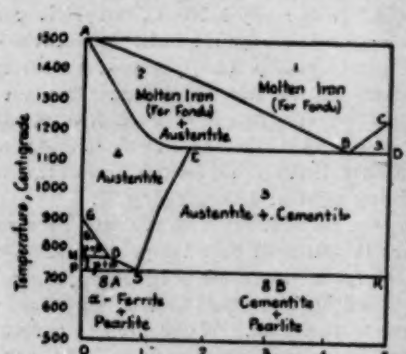


Fig. 1.

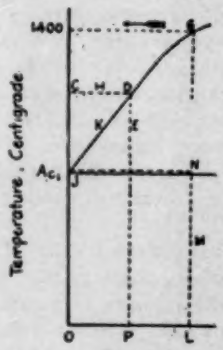


Fig 2.

portional to this temperature. If it is then reheated the grain size will remain the same until Ac_1 has been reached. Immediately on passing this, (as at N), the grain is refined to the minimum, that is, from N to J. If the temperature is still further raised the grain size increases progressively, as shown by the curve J D G, and this cycle of changes can be repeated indefinitely, provided the steel is allowed to cool uninterruptedly from the maximum temperature above Ac_1.

We will now consider how heat treatment can be employed to obtain the best results. To this end we must secure as far as possible:

1. A fine grain size.
2. Fine and uniform distribution of the carbon and allied constituents.

Only in the case of eutectoid steel can this combination be met by simple treatment. What this is will be clear after considering a more complex (and usual) case. For the purpose of discussion let us select a piece of steel containing about 0.40 to 0.50 per cent. of carbon. The steel as received will have been slowly cooled after rolling or forging. Its structure consequently will be made up of relatively coarse grains consisting of pearlite surrounded by or interspersed with envelopes or bands of ferrite, the latter being formed in cooling through the critical range between Ar_1, Ar_2 and Ar_3 (O S and P S in Fig. 1). In order to obliterate this segregated ferrite it is necessary to obtain a homogeneous solid solution by reheating past Ac_3; subsequent cooling, if sufficiently rapid, will retain this solid solution when the piece is cold.

The temperature having considerably exceeded Ac_1, the grain size is not at a minimum (Fig. 2). By reheating again past this lower critical point, however, the grain will be reduced. During this last reheating the excess ferrite has separated out, but at the temperature necessary, and provided the operation has been rapid, it has not had sufficient opportunity to segregate in any marked degree. The piece should then be rapidly cooled to prevent further segregation, and if harder than desired can subsequently be reheated to the proper temperature below Ac_3.

These operations may be summarized as follows:

1. Heat (at any rate) just above Ac_3 and cool rapidly.
2. Heat rapidly just above Ac_1 and cool rapidly.
3. Heat rapidly to whatever temperature (below Ac_1) is necessary, and cool rapidly or slowly, depending on the temperature.

In practice the combination of operations 1 and 2 is often referred to as "double quenching," and of 1, 2 and 3 as "triple quenching." Such refinements of treatment are, however, usually unnecessary for ordinary purposes, even when possible.

These are the fundamental principles of heat treatment, true for commercial work as for laboratory experiments, but in the former the effect of mass is an additional factor in the problem, responsible for much trouble and misunderstanding. Following are the operations commonly employed in heat treatment:

Annealing.—Reheating to a certain temperature, followed by slow cooling. To obtain the maximum benefits, including refinement of the grain, it is necessary to heat slightly above the upper critical point, Ac_3; this is sometimes referred to as "true annealing."

Hardening.—Heating to a temperature above Ac_1, usually above Ac_3, followed by rapid cooling. This is usually secured by quenching in some liquid such as water or oil; if the section is sufficiently small, this effect may be obtained by air cooling.

Tempering or "Drawing Back."—Reheating after hardening; similar to annealing, but usually to a lower temperature, in order to remove excessive brittleness, and affect the hardness as little as possible.

In experiment relatively very small pieces are employed, and it is possible to heat or cool them nearly uniformly throughout. For example, if a piece of fine wire is heated and then exposed to air, it will be cooled almost instantaneously, while the time required in the case of a large shaft, even when plunged into cold water, will be many minutes. Under similar conditions the rate of heating and cooling is much less for a large than for a small section, for two reasons: First, the distance to be traversed from surface to center, in the absorption or dissipation of heat, is greater. This rate progressively decreases as the temperature of the body, or of one portion of the body in relation to another portion, approaches that of the source of heat or refrigeration, in accordance with one of the fundamental laws of thermodynamics.

Second, because the cross-section increases directly as the square of the diameter, while the circumference increases only in simple proportion to the diameter. The same relation also exists between surface and volume (mass).

The preservation in the cold state of the condition which existed at the temperature to which an object is heated (above the critical point) is dependent upon a certain rate of cooling, irrespective of the size or mass of that object. With the means at our command it will readily be appreciated that a point is very quickly reached when no method of cooling can compensate for the increase in mass, so that the rate of cooling decreases with corresponding increase in the actual time required. As a direct result the interior of large masses will be cooled so slowly as to have only the properties of smaller masses cooled in the same time, or, in other words, the effect has been that of annealing rather than of quenching, as these terms are commonly understood. The exterior portion, although considerably retarded in its cooling by the necessary transfer through it of heat from the interior will be benefited in proportion to the rate at which its temperature was brought below the critical range, the properties of different portions of such a piece being in inverse proportion to the distance from the surface.

The reason for the higher relation of properties in a small section over that in a large section, treated under the same conditions, would appear to be due principally to the condition of the carbon. This is also borne out by the difference in the properties of test specimens cut respectively from near the surface and at the centers of large sections, which has resulted in the clause in forging specifications that "the axis of the specimen shall be located at any point one-half the distance from the center to the surface and shall be parallel to the axis of the object tested," with a view to determining the average values.

Under suitable conditions of heating it is possible to secure a reasonably uniform temperature throughout a very large section. If the rate of cooling could then be controlled so that a large section could be cooled as rapidly (that is, in the same time) as a smaller object the uniformity of the material in the two cases should be the same. As a matter of fact, however, such a state of affairs cannot be attained, as the conduction from the center to the outside of a section of any

size is relatively slow for the reason already given, and cannot be hastened sufficiently by any means at our command. Even if such were not the case, there is another insurmountable object in the path. This is the possible introduction of excessive strains in large pieces, particularly where there is any irregularity of section. Rupture or incipient cracks resulting from this would not be corrected by any heat treatment alone.

We are therefore confronted with the contradictory state of affairs that the larger the section the more vigorous should be the cooling; and the more vigorous the cooling the greater the liability to excessive strains or rupture. While the component parts of the material may be advantageously affected, the object as a whole suffers From this it is evident that for any given size or section there is a maxi mum relation between the ductility and strength, which decreases as the dimensions increase; that if the strength is maintained constant the ductility must decrease, and *vice versa*.

It must consequently be realized that the possibilities as regards the physical properties of large sections is not so great as is the case of small sections, and this must be taken into consideration in drawing up the physical requirements for specifications. For, relating the case briefly, under similar circumstances:

1. The condition of the carbon and the grain size depend upon the temperature and the rate of cooling.

2. The rate of cooling depends upon the diameter or thickness of a given section, and probably also to a certain extent upon the length, or, in other words, upon the mass.

3. The rate of cooling through the critical range, and just below the lower critical point, is of much greater importance than during any subsequent tempering (after quenching).

To determine the uniformity of heating, the temperature must be of unquestioned accuracy. Further, the rate of heating must be carefully determined by experiment to secure proper penetration. It will be seen that the principles involved are comparatively simple. The main difficulty in carrying out the operations commercially is found in securing the necessary degree of uniformity. It is for this reason that special equipment is so essential. Of equal importance is the proper material, the composition of which must be definitely known, as variations, particularly in carbon, will result in different physical properties being secured under the same conditions of treatment.

One Other Necessity, Coming Down in Price.

The Welsbach Company with its last issue of advertising leaflets has sent this announcement to the trade:

"On and after August 1st, 1914, and until further notice, Welsbach mantles will be listed at the following prices:

Upright Mantles.

	Per 100.	Per Doz.
No. 717 "Welco" brand, double-wire cap.	$25.00	$3.25
No. 189 "Yusea" brand, ring-top cap.....	25.00	3.25
No. 197 Welsbach brand, ring top cap.....	25.00	3.25
No. 192 "Amber" brand, ring-top cap.	25.00	3.25
No. 199 Welsbach brand, double-wire cap	15.00	2.00
No. 991 "Mel-o-lite" brand, double-wire cap	15.00	2.00
No. 4 Welsbach brand, double-wire cap	10.00	1.50

Inverted Mantles.

No. 416 "Welco" brand, magnesia ring.	25.00	3.25
No. 1 "Reflex" brand, magnesia ring.	15 00	2.00
No. 5 "Amber Light" brand, magnesia ring	15.00	2 00
No. 4 Welsbach brand, magnesia ring.....	10.00	1.50

Trade Discounts Remain Unchanged.—The "Welco" brand, upright and inverted, formerly sold at 35c. will be now generally retailed at 25c. This brand is made from an artificial silk base, under a process perfected by the Welsbach Company. These mantles have a distinctive appearance, and maximum durability and brilliance. They are packed in rectangular boxes, which bear this endorsement over the signature of the President of the Welsbach Company: "Our tests justify the claim that Welsbach 'Welco' mantles will last 2,000 lighting hours (equal to 1 year's service) under normal conditions of use, without shrinkage, breakage or loss of light."

Nos. 189 "Yusea," 197-J brand and No. 192 "Amber Light" formerly priced at 30c. will now be generally retailed at 25c.; the "Reflex," No. 5 "Amber Light" inverted, and the uprights No. 199 and No. 991 formerly priced at 25c. now 15c.; the No. 4 Welsbach, both upright and inverted, will continue to be retailed at 10c.

The great progress made in modern gas lighting requires the development of still better gas mantles.

To supply the public with reliable and satisfactory mantles and to insure best gas lighting service possible, the Welsbach Company has made vast improvements in mantle manufacture in their factory during the year just ended. These improvements have resulted not only in this price reduction, but also in a standard of quality higher than ever.

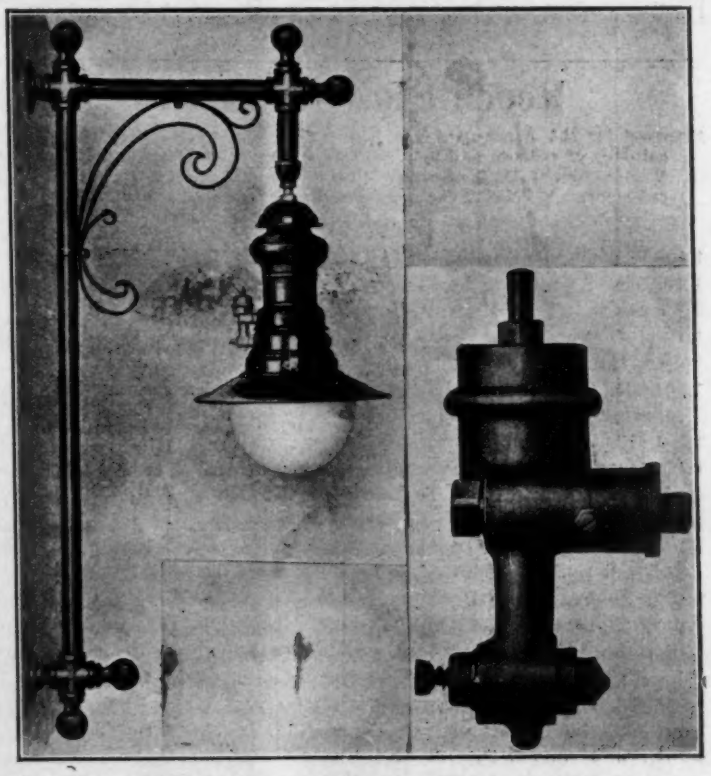
There is no question in the minds of the trade or the public of the superiority of the gas mantles bearing the Welsbach Shield of Quality, and now that this excellence is coupled with lower prices, the results to the dealers must be greater volume of sales, permanent basis of satisfaction among consumers, a greater increase in profitable lasting business.

An extensive advertising campaign beginning early this fall, will greatly increase the value of this new price policy to the dealers. Besides our own national advertising, which will be conducted directly in the dealer's favor, we shall supply attractive posters, hangers, window pasters, literature and ad plates for further local use to those who want them.

Every dealer in the land should get in touch with this new condition in the gas mantle market; should have his stock filled ready for this rare busness opportunity."

New Methods and Appliances.

NEW VALVE CONTROL FOR ARC LAMPS.—The General Gas Light Company has perfected a mercury valve for distant control of arc lamps that is a great step in advance of the chain-pull.



The complete lamp and the valve on a larger scale are shown in the cut.

A mercury valve on each lamp in place of the single pull-cock valve on the regular Humphrey No. 30 and 50 lamps, and a by-pass cock inserted in the line supplying the lamps, comprise the entire equipment.

The valve and its operation are extremely simple. The gas supply to the lamp is obstructed by a small inverted cup sealed in mercury, which at pressures below 18 tenths shuts off the supply at this point. Any pressure above 18 tenths raises the cup, permitting gas to pass to the burners. When the lamp is shut off the pilot, supplied from below the mercury seal, operates under one-inch pressure. The change of the gas supply to furnish gas to the pilots at one-inch pressure, or to the burners at normal pressure, is made by a by-pass cock in the line supplying the lamps.

The new valve can be bought separately and substituted for the valves on any Nos. 30 or 50 lamp, or may be specified on new lamps. This system of control gives all the advantages of an independent pilot line, without any chance of flashing back, and the mercury value is not affected by heat or cold, having no tight-fitting or ground surfaces.

MINIATURE BILL BOARDS.—The Peoples Gas Light and Coke Company of Chicago are using these "poster stamps" as stickers on their envelopes, bill heads, receipts and packages at the rate of thousands a month. They are artistically printed in colors and attracts so much attention that stamp enthusiasts are adding them to their collections.

Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by ROYAL E. BURNHAM, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 20 cents.

1,103,992. Gas Broiler. G. W. Murray, Atlantic City, N. J.

1,103,995. Apparatus for Trapping Particles in Suspension in Gas Currents. T. E. Murray, New York city.

1,104,116. Automatic Valve for Gas Fixtures. A. E. Hiertz, Bridgeport, Conn.

1,104 224. Gas Range. J. Roy, Cleveland, O., assignor to American Stove Co., St. Louis, Mo.

1,104,473. Gas Burner. F. M. Brooks, New York city.

1,104,515. Mantle for inverted Incandescent Gas Lamps and Method of Tying the same. E. L. Knoedler, Gloucester City, N. J., assignor to Welsbach Company, same place.

1,104,519. Gas Valve or Cock. T. J. Litle, Jr., Woodbury, N. J., assignor to Welsbach Company, Gloucester City, N. J.

1,104,522. Automatic Ignition System for Gas Lights. J. W. Lundahl, Thomaston, and O. A Ekstrom, Litchfield, Conn., assignors of one-half to said Lundahl, one-fourth to said Ekstrom, and one-fourth to Carl A. Larson, Thomaston Conn.

1,104,688. Meter. G. Mason, New York city.

1,104,865. Gas Regulator. C. Barrington, Jr , Los Angeles, Cal.

1,104,900. Means of Producing from Artificial Lights the Color Effect of Daylight. H. E. Ives, Mount Airy, Pa., assignor to The United Gas Improvement Co., Philadelphia, Pa.

1,105,027. Safety Gas Burner. J. Gaspar, Bridgeport, Conn.

1,105,031. Burner. H. F. Hagemeyer, Toledo, O., assignor to The Mechanical Process Mfg. Co., same place.

1,105,241. Method of an Apparatus for Producing Gas. G. H. Benjamin, New York city.

1,105,246. Attachment for use with Incandescent Gas Lamps. T. S. Browne, New York city.

1,105,250. Gas Burner. J. E. Carnahan, Canton, O.

1,105,259. Inverted Incandescent Lamp. P. Davies, London, England, assignor to Deutsche Gasgluhlicht Aktiengesellschaft (Auergellschaft), Berlin, Germany.

1,105,474. Gas Producer. J. A. Weil, Stockton-on-Tees, England.

1,105,522. Method of and Means of Working Coke Ovens. H. Koppers, Essen-on-the-Ruhr, Germany, assignor to H. Koppers Co., Chicago, Ills.

Items of Interest
FROM VARIOUS LOCALITIES.

FOR the purpose of testing gas and gas meters and estimating the values of gas properties in Chicago a bureau has been established in the department of public service. The new bureau, according to Montague Ferry, commissioner of public service, will work to obtain a reduction in the present gas rate to 50 cents a thousand cubic feet. B. M. Ferguson, gas expert, has been engaged by the department to assist W. D. Wilcox, deputy commissioner, in carrying on the work of the new bureau. The bureau is an outgrowth of the gas inspection department, which has for years conducted tests of the quality of gas and the accuracy of gas meters.

THE Richmond (Va.) council committee on "Public Buildings, Properties and Utilities" has still before it the proposition of the Southern Gas and Electric Company to lease or purchase the municipal gas works, but the matter will probably be dropped for all time.

THE Central Gas Company has been incorporated to do business in Central City, Ky. The incorporators are J. R. Freeman, Jr., S. J. Gish and L. B. Dunham.

THE Suburban Gas and Electric Company, Revere, Mass., has just completed a big piece of work in laying gas mains to the Point of Pines. A total length of pipes of about 15,000 feet has been laid in a little over a month, with the result that practically every house at the Pines is using gas today. Mains had to be laid along the boulevard from Oak Island and connections to 55 lamp-posts along the drive. The company removed its old-style lamps on the east side of the roadway and installed modern gas incandescents on the west side of the road from Oak Island north to the Pines.

AT the annual meeting of the stockholders of the Taunton (Mass.) Gas Light Company reports were presented and were satisfactory. The following officers were elected:

President—William C. Davenport.
Secretary and Treasurer—Walter T. Soper.
Directors—Frank L. Tinkham, William C. Davenport, Walter T. Soper, John Brown and Charles Davol.

THE Suffolk (Va.) Gas Electric Company have let contracts for a number of additions and extensions to their plant, which will begin at once. These improvements will embrace, among other things, a 100,000 foot holder, station meter, exhausters, etc. Mr. E. L. Rieha will be the engineer in charge of the new work. The company has lately been largely engaged in main extensions, and expects to continue along this line also.

MR. A. S. B. LITTLE has been engaged as Gas Engineer by the Public Utilities Commission of Illinois, and left for Springfield on August 3rd. Mr. Little leaves Nashville with the regrets and sincere good wishes of his business associates; and all his friends in the industry offer congratulations to him and to the Commission.

THE Bartlett-Hayward Company have begun the erection of the new 500,000 foot holder at Auburn, N. Y., for the Empire Gas and Electric Company, having completed the six million holder at Rochester, N. Y., for the Rochester Railway and Light Company.

THE new auxiliary gas plant of the Ottawa Gas Company, on Lees avenue, is rapidly nearing completion under the direction of Mr. Frederick Burnett, consulting engineer of the gas company. It is expected that the new works will be started up in October, by which time the stack of vertical benches will be completed. The benches and plant generally will be of great interest to the gas men who attend the convention of the Canadian Gas Association in September next, as many up-to date features have been introduced for the first time in Canadian gas works.

MR. WALTER A. ALLISON, for the last 4 or 5 years Chief Engineer for the C. H. Geist Company, has resigned from that organization to look after some private business interests. It is his intention to reenter the gas industry early in 1915.

AT the annual meeting of the St. Johnsbury (Vt.) Gas Company this board of directors was elected: H. J. Goodrich, George Asselin, Charles F. Weeks, L. P. Leach and F. M. Abbott. The organization is unchanged, Mr. Abbott, President; Mr. Goodrich, Vice-President; R. H. Eaton, Secretary and Treasurer; and Charles L. O'Laughlin, General Manager.

THE case of the Twin State Gas and Electric Company against the City of Dover, New Hampshire, soliciting an abatement of the taxes, and which was referred to the State Tax Commission by the Superior Court, has been adjusted. Dr. Louis Bell, the Boston engineer, was decided upon by the counsel involved to adjust the values, and in the presence of George T. Hughes, Allen Hollis and Irving L. Meloon, representing the company; City Solicitor Sherry and Attorney Dwight Hall, representing the city; William F. Rines, the assessor, and Albert O. Brown, the tax commission, Mr. Bell stated that the valuation of 1913 and 1914 of approximately $625,000 was a fair estimate, as he had learned that five eighths of the taxable property was situated in the city, while the remainder was located in other municipalities.

HEARING of the suit brought by the St. Paul (Minn.) Gas Light Co. to enjoin the City of St. Paul from putting into effect the 85-cent gas ordinance will be in United States District Court before Judge Wilbur F. Booth. The injunction is asked on the ground that the 85-cent rate set by the city is confiscatory. The answer of the city has been served on the plaintiff company. It embodies affidavits made by Prof. Edward W. Bemis, Charles L. Pillsbury, consulting engineer; O. H. O'Neill, corporation counsel; E. P. Davis and Henry Rothschild. The last two affidavits concern the value of the real estate owned by the gas company. The city, through its Corporation Counsel, will argue that the rate is not confiscatory, and that it was made only after a complete investigation of the company's business was made by E. W. Bemis, statistician and rate expert, and Charles L. Pillsbury.

THE Pittsfield (Mass.) Coal Gas Co. sold 205,995,600 cubic feet of gas last year, an increase of 16.7 per cent. over the preceding year, according to report made at the annual meeting of the Company. The total income from the sale of gas was $299,509.91. The number of meters increased 768 during the year, making a total of 8,885 now in use. The number of gas ranges and water heaters in use was 8,353, an increase of 1,040. Five and a half miles of new mains were laid, bringing the total to 76 miles; and 1,550 arc lamps are in service. Notwithstanding these increases the net profits of the company were smaller than in years, because of increased prices for gas-making material, and the decrease in the price of gas which became effective January 1, at which time the price was reduced from $1.08 to $1 per 1,000 feet. A semi-annual dividend of 3 per cent. was declared, and officers elected as follows: President, William L. Adam: Vice-President, George H. Tucker; Treasurer, H. A. Dunbar; Manager, H. C. Crafts; Directors, William L. Adam, George H. Tucker, W. G. Backus, T. F. Plunkett, N. C. Hull, I. D. Ferrey and A. H. Rice.

THE Flatbush Gas Company (Brooklyn, N. Y.) Employees Association held their annual picnic last week at Morningside Park, Jamaica L. I. The weather being everything that could be expected, a large number of members attended, with their families and friends. The athletic events were held in the afternoon, under the management of C. W. Ruprecht, Jr., Hans J. Gerlick and E. J. Devlin. The following were winners in various events: Shot put, J. McTague; 60 yard dash, Herbert Farrell; fat man's race, W. Bramerloh; ladies' race, Miss Mathews; 3-legged race, George Major and H. Farrell; Children's race (boys), E. Mohring, (girls) E. Carlson; standing broad jump, James F. Conover. After the prizes had been awarded all adjourned to the dance hall for the dancing contest. The prizes, two silver loving cups, were won by Mr. Westburg and Mrs. P. Superty. The judges in this contest were A. R. Gledhill, F. Little, T. McNeeley, J. McTague and F. Roche. Dancing followed for the rest of the evening. These are the officers of the Association: James A. Kenney, President; Walter P. Shield, Vice-President; Charles G. Seeba, Treasurer; Thomas J. Grant, Jr., Secretary.

THE 75 cent gas rate fixed for San Francisco by the Board of Supervisors, is unconstitutional, void and confiscatory according to the report rendered by the Uuited States Master in Chancery, H. M. Wright. This report comes as a surprise to the authorities, as last May, in a preliminary draft, the Master indicated that he did not think 75 cents confiscatory. He now explains that he was in error as to the net income of the Pacific Gas and Electric Company, which he says he has found to be $627,577.75 instead of $722,468.46; and that the company is getting only 5.21 per cent. on its investment, and should be entitled to 6 per cent. He recommended that an injunction be issued restraining the city from enforcing the 75 cent gas rate. The company has been collecting 85 cents under the terms of a temporary injunction, and the amount in excess of the rate fixed by the Board of Supervisors has been impounded, to a total of $284,325.11. The report goes to Judge Van Fleet for final decision.

PROF. WILLIAM L. PUFFER, the expert in lighting affairs, who appeared in the investigation of gas matters in North Adams, Mass, a few years ago, is now engaged in appearing for consumers of gas in Marlboro, Southboro and Hudson, who are seeking a reduction in rates from the Marlboro-Hudson Gas Company. It was the work of Prof. Puffer in the local case which called to him the attention of the petitioners in the present matter, and there is danger of further temporary inflation.

EMPLOYEES of the Haverhill (Mass.) Gas Light Company enjoyed their annual outing on July 28, at Canobie Lake Park. Two special electric cars were secured for the outing and were boarded at Washington Square about 8.30 o'clock. All branches of the business were shut down, and the participants in the outing included every department, even the office of the company being closed for the day. About 150 went on the outing, and they were all wearing yellow tags. The committee in charge was Michael Wrenn, J. W. Murphy and James Cronin.

MR. EDWARD H. WINSLOW was elected a member of the Board of Directors of the Beverly (Mass.) Gas and Electric Company, at the annual meeting, to fill the vacancy caused by the death of Charles F. Prichard, of Lynn. The other directors and officers were reelected.

WHEN the various concerns interested in the Strong Building in Springfield, Mass., recently damaged by fire, took inventory of their stock, the Springfield Gas Light Company had perhaps the most peculiar experience. The representatives of the company found that the quarters in the prepayment meters had been welded together by solder and soft metal in the coin boxes which had melted. The quarters can be recovered by the application of sufficient heat to melt the holding metal without doing damage to the money.

THE Millville (N. J.) Gas Light Company is extending its mains into Landisville, Atlantic county.

THE Gas Company, of Mt. Union, Pa., has been chartered, its application having been approved by the Public Service Commission. R. M. Longacre is named as President.

MR. HOWARD S. MCNAIR, who has been in charge of the office of the United Gas and Electric Company since it took active direction of affairs in the street railways situation in New Orleans, has been appointed Secretary and Treasurer of the American Cities Company, succeeding R. E. Slade, who has resigned that place, as well as the management of the gas department of the New Orleans Railway, Light and Power Company, to take effect in October. Mr. McNair was Secretary to President McCloskey when he was at the head of the railway company, and subsequently filled the same position when he became President of the American Cities Company. Mr. McCloskey said that another manager for the gas department would be selected, but he did not know who it would be. Mr. Slade, in confirming the report of his resignation, said he had no present plans.

THE Compressed Gas Association, Mr. John J. O'Rorke, Secretary, 25 Madison Avenue, New York city, wants manufacturers of Valves, Cylinders, Recording Gauges, Filling and Weighing Stands, and all material and appliances which enter into the manufacture, transportation and sale of compressed gases to regularly send their catalogues, price lists, and full descriptive details to the Secretary, so that enquiries in these relations by members may be promptly satisfied.

MR. J. J. HUMPHREYS has resigned as manager of the Gas Light Company of Augusta, Ga., and is succeeded by Mr. F. L. Marshall. Mr. Wm. H. Matlack, Jr., succeeds Mr. Marshall as Superintendent of the Henrico County Gas Company, Richmond, Va.

Utilities Commission News.

BRIDGEPORT RATE STANDS.—The Connecticut Public Utilities Commission has denied the petition for a reduction in rates in Bridgeport. The commission held an exhaustive hearing on the petition and on January 2, 1914, decided that the petitioners had made out a *prima facie* case and denied the company's motion to dismiss the petition. The company was ordered to file a valuation of the property and a list of its salaried officers with the amount of salaries. The estimate of the value of the property as of December 31, 1913, was $3,417,034. The present capitalization of the company is $3,000,000. The present rate for gas is $1.10 per 1,000 cubic feet, less 10 cents for payment by the 10th of the month. The report says: "The evidence shows that from 1851 to 1875 no dividends were paid, all earnings above expenses being put back into the plant for extensions, etc. From 1876 to 1901 10 per cent. dividends were paid annually. In 1901 a stock dividend of $700,000 was declared. From 1902 to 1908 no further dividends were paid. In 1909 a stock dividend of $350,000 was declared, and additional dividends amounting to $382,500 have been paid previous to June 30, 1913. A computation will show that since 1851 there has been paid in cash and in stock dividends nearly two and one-fourth million dollars, which, if distributed over the entire period of the company's life would have paid over 7¼ per cent. in dividends on the stock outstanding each year."

The finding and order of the commission are as follows:

"Under all the circumstances connected with this case the commission is of opinion that the present rate of return is fairly liberal and that should the company's business increase during the next few years in the ratio of increased income and expenses shown during the past 10 years a reduction of rate should be anticipated. On the other hand, considering the risk assumed, the increasing cost of operation, the better and more extended service that can fairly be required of and furnished by a company with a fair margin of profit above mere compensation, we are of opinion that the present rate of the company is not unreasonable.

"For the reason herein stated the petition is denied."

DENIES RIGHT OF COMMISSION TO FIX VALUES.—Springfield (Mo.) Gas and Electric Company, in a motion for a new hearing, filed with the Public Service Commission, challenges the right of the Commission to say that transactions of a utility are fraudulent or to fix, arbitrarily, the value of plant properties at a figure far less than the book value. The petition declares that the Commission is an administrative body, created by the Legislature and, when passing on questions of a judicial nature, is violating the constitution of the United States and of the State of Missouri. The recent order of the Commission reducing the rates of the Springfield Company and fixing 7 per cent. as a fair return on their investment, is attacked as "unfair, unjust and unreasonable." The Commission also lopped off from the operating expenses account $18,000 per year, paid to officers of the Federal Light and Traction Company, of which the Springfield concern is a subsidiary. The petition declares the officers of the New York Company render services worth that amount to the local company.

EARNING ITS WAY.—The Illinois Public Utilities Commission, in existence since Jan. 1, 1914, promises to earn in fees enough to pay all its expenses. This possibility is set forth in a report to Governor Dunn by Chairman James E. Quan of the Commission. "The receipts of the State Commission from Jan. 1 to May 21, inclusive, were $89,511.09," says Chairman Quan. "The expenditures were $34,475.50. This shows the receipts from fees and other charges were $55,035.59 in excess of moneys spent from our appropriation. These items do not include salaries of the Commissioners, Chief Counsel and Secretary, which amount to $23,881.57. The total receipts of the Commission were $31,154.02 greater than the total expenses including Commissioners', Chief Counsel's and Secretary's salaries and expenses and all other charges paid from the appropriation."

HAS NO AUTHORITY.—The Ohio Commission has decided it is without authority to direct the Attorney-General to proceed against gas companies to collect penalties for non-compliance with ordinances directing the companies to make extensions of service into suburban districts. The matter came before the commission in the case of the Cincinnati Gas and Electric Co.

Financial Notes.

A PETITION in equity has been filed by the Surety Trust Company, of Harrisburg, Pa, asking that receivers be appointed for the Northumberland Gas, Heat and Fuel Company, with offices at Northumberland, Pa. In the petition it is alleged that the Surety Trust Company were given a first mortgage against all the property of the Gas Company as security for an issue of $75,000 in bonds. Of this amount $30,000 were sold, and for the past 2 years the company has failed to pay the interest accrued upon the bonds and that it is now insolvent.

THE gross earnings of the Pawtucket (R. I.) Gas Company for the first 6 months of the present year amounted to $57,162.55, 2 per cent. of which, $1,152.25, was turned over to the city of Pawtucket for the privilege of an exclusive franchise.

IN accordance with its usual custom, the New England Coal and Coke Co., set aside from its earnings for the fiscal year ended June 30, for depreciation on fleet and coal cars and addition to reserve accounts for extraordinary repairs, etc., the sum of $214,027, compared with $168,321 in previous fiscal year.

The New England Gas and Coke Co. and Boston Tow Boat Co. made no allowances during the past year for extraordinary repairs, etc., compared with $26,007 and $8,516 respectively set aside for this account in fiscal year ended June 30, 1913. In the case of these two companies no allowances were necessary this year.

THE 29th annual report of the Massachusetts Gas and Electric Commission for fiscal year ended June 30, 1913, is issued. Consolidated statement of 67 gas companies follows:

	1913.	1912.
Income	$14,091,982	$12,858,592
Expenses	10,112,265	9,306,046
Net	3,979,717	3,704,196
Deficit after dividend charges, etc.	6,121	*352,989

*Surplus.

Seven companies did not earn expenses against 13 in 1912, and 12 did not earn enough to warrant a dividend declaration. Consolidated statement of 55 electric companies follows:

	1913	1912
Income	$15,128,212	$13,580,031
Expenses	8,995,055	7,986,448
Net	6,133,157	5,603,682
Surplus after dividend charges, etc..	29,698	232,587

Six companies did not earn expenses against 3 in 1912, while 16 companies against 12 in 1912 failed to earn enough to warrant a dividend declaration.

Municipal plants in three cities and 33 towns, of which 4 supply both gas and electricity and the others electricity, report as follows:

Electricity.

	1913.	1912.
Income	$1,052,498	$916,227
Expenses	839,176	765,910
Net	213,321	150,317
Surplus after depreciation, etc	2,710	68,106

Gas.

Income	$290,188	$282,118
Expenses	212,244	205,813
Net	77,944	76,305
Surplus after depreciation, etc	71,009	60,605

Actual surplus of all gas companies, according to balance sheets, was $7,891,268, or 20.63 per cent. on capital compared wit $9.257,043, or 25.41 per cent. the previous year. Gas plants were assessed at $48,000,000 and paid $1,164,809 in taxes, or 7.4 cents per 1,000 cubic feet sold, a decrease of .2 per cent. per 1,000 feet from 1912. There was $3,599,451 paid in dividends by 54 gas companies, or 9.6 per cent. on capital stock. 14 companies reduced the price of gas, including Cambridge and Charlestown companies, both reducing from 85 to 80 cents. Average price paid by consumers of coal gas was 86.4 cents, against 85.7 in 1912, and $1.72 in 1886.

Actual surplus of electric companies was $3,740,000, or 12.22 per cent. on stock, against $3,536,198, or 13.27 per cent. in previous year. Assessed value of electric plants is $48,827,797, and total tax paid was $1,422,457. 41 electric companies paid $3,012,288 in dividends or 9.9 per cent on stock.

Towns of Middleboro, Wakefield and Westfield and the City of Holyoke operate gas plants. Impurities prohibited by statute were found once in Holyoke, four times in Wakefield and twice in Westfield. The candle power was found below the legal standard once in Wakefield. The average price received in Holyoke was $1 per 1,000; in Middleboro, $1.58; in Wakefield, $1.30; and in West[illegible] $1.08.